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ISHIHARA (T.). **The developmental Stages of some Bugs injurious to the Kidney Bean (Hemiptera).**—*Trans. Shikoku ent. Soc.* **1** pt. 2 pp. 17–31, 4 figs. Matsuyama, 1950.

In the Matsuyama district of Shikoku, Japan, kidney beans are seriously injured by Hemiptera, particularly in summer, and seed crops are often completely destroyed. In 1949, *Nezara antennata* Scott and *Piezodorus hybneri* (Gmel.) (*rubrofasciatus* (F.)) were found attacking the pods, stems and leaves, *Coptosoma punctatissimum* Mont. the stems, *Riptortus clavatus* (Thnb.) the pods, *Anacanthocoris concoloratus* (Uhl.) the stems and leaves and *Lygus pratensis* (L.) and *Tettigella* (*Cicadella*) *viridis* (L.) the leaves. *N. antennata*, *R. clavatus* and *A. concoloratus* were the most injurious ; *P. hybneri* was common but did comparatively little damage, *Coptosoma punctatissimum* was less common on kidney bean than on soy bean or broad bean, and *L. pratensis* and *T. viridis* caused negligible injury. Very brief notes are given on the distribution and habits of *N. antennata*, *R. clavatus*, *A. concoloratus* and *P. hybneri*, together with descriptions of the eggs and nymphal instars of each and keys to the latter.

BROWNE (F. G.). **Tests of Preservatives against Ambrosia Beetles in Malaya.**—*Malay. Forester* **12** no. 4 pp. 174–189. Kuala Lumpur, 1949.

In tests of materials for the protection of timber from natural infestation by wood-boring Scolytids and Platypodids in Malaya, freshly cut logs were brushed until thoroughly drenched with the test compounds, alternated with untreated ones in rows, which were raised slightly above the ground, and inspected at weekly intervals for eight weeks, or for less if heavy infestation developed.

The results showed that pentachlorophenol (as a 5 per cent. solution in aromatic gas oil, a 2 per cent. solution of sodium pentachlorophenate in water, and a proprietary preservative), dimethyl phthalate, and DDT (at 14 per cent. in xylene) were ineffective, though dimethyl phthalate may have had a repellent action for a week or more. Coal-tar creosote (alone and in diesel oil) proved highly attractive to the beetles, which reproduced in treated logs. Parathion gave inconclusive results, but it was evident that only a high concentration that would be unpleasant and dangerous to use would be effective. BHC (benzene hexachloride) was tested as a concentrate of the γ isomer in oil (which was diluted with kerosene) and as the crude compound in a wettable powder (6·5 per cent. γ BHC). Some protection was given in some cases by the concentrate diluted to contain 1·75 per cent. γ BHC, but the minimum concentration that would give full protection for two months was apparently 3–3·5 per cent. The wettable powder, even at the low concentration of 0·65 per cent. γ BHC, was probably toxic to all the beetles for at least two months, but was easily washed off by rain. Its greater efficacy as compared with the concentrate may have been due to the presence of the other isomers.

The Scolytids present were mainly species of *Xyleborus*, and the Platypodids mainly *Platypus* and *Crossotarsus* spp. The Bostrychid, *Xylothrips flavipes* (Ill.), and the Cerambycid, *Dialeges pauper* Pasc., also occurred, and infested logs treated with pentachlorophenol.

JENKINS (C. F. H.) & FORTE (P. N.). **The Argentine Ant in Western Australia.**—*J. Dep. Agric. W. Aust.* (2) **28** no. 3 pp. 324–335, 4 figs., 3 maps, 8 refs. Perth, W.A., 1951.

Iridomyrmex humilis (Mayr) has steadily extended its range in Western Australia in recent years [*cf. R.A.E.*, A **39** 33], but by 1951, major infestations were still restricted to Albany, Bunbury, and Perth and its environs, including Fremantle. A campaign for the eradication of the ant from Fremantle by

spraying with DDT was undertaken in 1950. Litter and weeds likely to interfere with the treatment were removed, and a cover spray comprising an emulsified solution of 2 per cent. DDT was applied over the whole of the infested city area, particular attention being given to drains, trees, which were sprayed to a height of about 6 ft., shrubs, fences and house foundations. The spray was to be applied at about 80 gals. per acre, but it was not always possible to restrict the rate, and some built-up areas received about 120 gals. per acre. Infestation was greatly reduced, but the ant was eradicated only where the treatment was followed by baiting and spraying by householders, and since the campaign was costly, it was largely abandoned. Complete eradication from limited areas is thought possible, however, but depends as much on the perseverence and co-operation of the inhabitants as on the efficacy of the methods employed.

An attempt was also begun to eradicate the ant from a suburban institution covering an area of 7½ acres and entirely surrounded by tarred roads. Weeds and branches of trees and shrubs in contact with the ground or with the buildings were removed, and the entire ground surface was sprayed with an emulsified solution of 2 per cent. DDT ; one week later, only one active nest was found. Activity indoors then increased, but was greatly reduced by painting skirting boards, window frames, etc., with a solution of 4 per cent. DDT in kerosene and subsequently controlled by means of poison baits. Periodic surveys showed that active nests were still associated with six large, hollow *Eucalyptus* trees in the grounds. Poison bait (United States Government formula [**8** 285]) was applied throughout the winter, but the ants varied in their reaction to it, and some that evidently had adequate alternative food supplies did not take it for several months. In early summer, the trees were grubbed up and burnt, and subsequent isolated infestations resulting from ants that migrated from them were controlled by spraying with 1 per cent. DDT. At the time of writing, weak colonies were occasionally found in a part of the garden where kitchen refuse was regularly buried. In further investigations, an area in each of two suburbs was kept free from infestation for three summers by spraying the boundaries twice each summer with an emulsified solution of 20 per cent. DDT and subsequent spot spraying and baiting.

Some observations on the habits of *I. humilis* and its association with Aphids and Coccids are included. Queens have not been observed to fly, but frequently follow foraging trails, thereby increasing the effectiveness of sprays and baits, but also the risk of distributing the ants on merchandise. There is some evidence that isolated workers form bands that can persist for some time. Natural spread appears to be comparatively slow, and the relatively rapid extension of the range in Western Australia is attributed to artificial dissemination by means of pot plants, nursery stock, stable manure and merchandise. No colonisation of uncultivated bush has occurred except at Albany, where dry scrub close to infested houses and a swamp area have been invaded. Tarred roads with much traffic may constitute effective barriers, except where drains or other underground channels provide alternative routes.

HEATH (D. F.), LANE (D. W. J.) & LLEWELLYN (M.). **Studies on commercial Octamethylpyrophosphoramide. III. Decomposition of the Insecticide in Plants, using ^{32}P as a Tracer.**—*J. Sci. Fd Agric.* **3** pp. 60–69, 2 graphs, 14 refs. London, 1952. **IV. The Decomposition of Pyrophosphoric Acid Tetra(dimethylamide) and Orthophosphoric Acid Tri(dimethylamide) in the living Plant.**—*T.c.* pp. 69–73.

These two parts of a series [*cf. R.A.E.*, A **40** 147] contain the results of experiments in Britain in 1950 on the persistence and decomposition in plants of Pestox 3 and three of its constituents, all of which were made radioactive by synthesising them from P^{32}. Of these constituents [*cf. loc. cit.*], schradan is

referred to as octamethyl pyrophosphoramide, pyrophosphoric acid tetra(dimethylamide) or $R_4P_2O_3$ ($R=Me_2N$-), its higher homologue (triphosphoric penta(dimethylamide)) as $R_5P_3O_5$, and a minor constituent as tri(dimethylamino)phosphine oxide, orthophosphoric acid tri(dimethylamide) or R_3PO.

In the tests described in the first of the two parts, strawberries, sugar beet, hops and brussels sprouts were sprayed between May and October with Pestox 3, containing about equal parts of schradan and triphosphoric penta(dimethylamide) ; 5–10 times the normal concentration of wetting agent was included to ensure reasonably even leaf coverage. Analysis of the crops at various intervals after spraying showed that the concentrations of the two insecticides in the plant fell at much the same rate, and that this rate varied little between plant species for treatments made at the same time of year, but varied with season, being rapid in May and June, falling somewhat in July–October and becoming negligible (in brussels sprouts) in winter. At midsummer, 90 per cent. disappeared in about 40 days. It was shown that the plants decomposed the insecticides and that removal of radioactive material from them was always preceded by decomposition, the decomposition products being removed by root excretion, vaporisation, or washing out of the leaves by rain. Triphosphoric penta(dimethylamide) was absorbed much more slowly than schradan, probably at about a quarter of the rate, and this large difference is consistent only with membrane absorption. In brussels sprouts, the highest concentrations were found in the lower leaves and stumps, whether the plants were sprayed from above only or from all directions. Uptake by the roots was demonstrated in an additional experiment in which sprouting dahlia tubers were watered with solutions.

The second of the two parts contains the results of tests in which sprays of schradan and tri(dimethylamino)phosphine oxide were applied to strawberry and sugar beet in September or October. The two compounds were decomposed at similar rates in either plant, and analysis of beet plants 10–14 days after treatment with schradan showed that radioactive phosphorus existed in them only in the original compound and decomposition products not extractable from water by chloroform, whereas those treated with tri(dimethylamino)-phosphine oxide contained in addition to the original material at least one compound that partitioned somewhat in favour of chloroform from N-sodium hydroxide and somewhat in favour of pure water from chloroform. It is concluded that the plant probably oxidises both compounds by enzyme attack.

China (W. E.) & Carvalho (J. C. M.). **The "*Cyrtopeltis-Engytatus*" Complex (Hemiptera, Miridae, Dicyphini).**—*Ann. Mag. nat. Hist.* (12) **5** no. 50 pp. 158–166, 3 figs. London, 1952.

Reference is made to the confusion that has existed in the generic classification of this group [*R.A.E.*, A **26** 688, etc.], and the scope of *Cyrtopeltis* is extended to include *Nesidiocoris* (of which *Gallobelicus* is a synonym) and *Engytatus* as subgenera. Three new subgenera of this genus are erected. Keys differentiating the genera *Macrolophus*, *Dicyphus* and *Cyrtopeltis*, and the subgenera of *Cyrtopeltis* are followed by descriptions of these subgenera and lists of the species included in them, showing their synonymy and distribution.

C. (*Dicyphus*) *lurida* (Gibson), *C.* (*Leptoterna*) *nicotianae* (Kon.), and *C.* (*Neoproba*) *varians* (Dist.), which belong to the subgenus *Engytatus*, and *C. tenuis* Reut., which is, by synonymy, the type of *Nesidiocoris*, are all distinct species [*cf. loc. cit.*]. *C. lurida* is the first available name for *E. geniculatus* Reut. which is preoccupied in *Cyrtopeltis* by *C. geniculata* Fieb. ; it has long been considered that *C. varians* is identical with this species, but examination of the type of *varians*, which was described from Guatemala, has shown that it is distinct. The synonyms of *C. tenuis* include *Gallobelicus crassicornis* Dist., and *Dicyphus nocivus* Fulmek.

RICHARDS (A. G.). **The Integument of Arthropods : the chemical Components and their Properties, the Anatomy and Development, and the Permeability.**—9¼×6 ins., xvi+411 pp., 65 figs., 77 pp. refs. Minneapolis, Minn., Univ. Minn. Pr. ; London, G. Cumberlege, Oxford Univ. Pr., 1951. Price $6 or £2 8s.

This review of information on the integument of arthropods (here regarded as the external covering tissue and the structures derived from it) is based on literature published for the most part up to the end of 1949, much of which relates to insects. The first of its three main sections (pp. 9–142) deals with the cuticle and includes information on the molecular structure and chemical properties of its components and the proportions in which they occur, the detection and estimation of chitin and its occurrence in different groups of the plant and animal kingdoms, and the physical properties of the cuticle and of chitin and other constituents, including wettability. The second section (pp. 145–282) is concerned with the anatomy of the integument, the structure, composition and origin of the different layers of which it is composed, the various appendages, muscle attachments, and glandular and other structures associated with it, the tracheal system, and the process of moulting and the factors initiating it. The third section (pp. 285–319), on the permeability of the cuticle, contains accounts of the general properties of membranes, the relation of the structure of the cuticle to permeability, and the penetration of gases and liquids, including insecticides, with a discussion of methods that have been adopted for the study of cuticle permeability.

CHANG (Peh-I). **The Action of DDT on the Golgi Bodies in Insects nervous Tissue.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 311–326, 13 figs., 52 refs. Columbus, Ohio, 1951.

Since DDT is known to affect the nervous system of insects, its effect on the Golgi bodies, one of the important constituents of the nerve cells, was investigated. The test insects were nymphs of *Periplaneta americana* (L.) and workers of the honey bee, and comparisons were made with BHC (benzene hexachloride), which is not a nerve poison. The bees were confined in cartons smeared with 10 per cent. DDT or 6 per cent. technical BHC in acetone, and the cockroach nymphs had 50 mmg. technical DDT (6 per cent. acetone solution) injected into the abdomen or were shaken up with dry technical BHC. Thoracic ganglia of both species and abdominal ganglia of the cockroaches were dissected from treated insects classified as knocked down, moribund or dead and from untreated ones, fixed with a solution of cobalt nitrate and formalin, impregnated with silver nitrate, reduced, and stained. The procedure is described in detail. Examination of specimens showed that the Golgi bodies in insects treated with BHC underwent a rather usual process of breaking up, whereas those in insects treated with DDT usually began to break up early in the knockdown stage and had almost vanished in dead insects, indicating that DDT has an effect on insect ganglionic cells that accelerates the breakage of the Golgi bodies.

ROEDER (K. D.) & WEIANT (E. A.). **The Effect of DDT on sensory and motor Structures in the Cockroach Leg.**—*J. cell. comp. Physiol.* **32** no. 2 pp. 175–186, 2 figs., 11 refs. Philadelphia, Pa., 1948. **The Effect of Concentration, Temperature, and Washing on the Time of Appearance of DDT-induced Trains in sensory Fibers of the Cockroach.**—*Ann. ent. Soc. Amer.* **44** no. 3 pp. 372–380, 3 figs., 6 refs. Columbus, Ohio, 1951.

The following are the authors' summaries.

Using a method which combined dissection, ablation, electrical stimulation, and recording, it was possible to show that not all structures in the cockroach

leg are equally sensitive to the unstabilizing effect of DDT. Single injections of aqueous suspensions containing 0·01 to 10·0 ppm. DDT caused impulse trains to appear in nerves which received fibers from campaniform organs. Excision of the campaniform organs stopped the DDT-induced trains without affecting the normal-appearing discharge from other sense organs (spines and hair sensilla). Observations on the effect of DDT on the electrical activity of neuromotor preparations and of the cercal nerve confirm the conclusion that the structures in *Periplaneta americana* most sensitive to the action of DDT are the campaniform sensory cells.

Oscillographic recording reveals that trains of impulses appear in afferent fibers of the crural nerve of the cockroach only when a definite period of time has elapsed since the injection of DDT through the leg. The log time of onset of trains is inversely proportional to the log concentration of DDT particles in the suspension. The time of onset of trains after injection of a suspension containing 1·0 ppm. DDT is unaffected by temperature between 12°C. and 32°C., suggesting that the interval is occupied by a physical process. The effects of injection of 0·3 ppm. DDT could not be removed by washing repeatedly with saline, though the trains of impulses did not appear for 17 minutes. It is suggested that DDT is immediately bound at the surface of the sensory neurones, the time interval between application and the appearance of impulse trains being occupied by solution of DDT in a lipoid layer below the neurone surface. The attainment of a critical concentration at this lipoid layer is indicated by the appearance of impulse trains in the afferent fibers.

KONST (H.) & PLUMMER (P. J. G.). **Acute and chronic Toxicity of Parathion to warm-blooded Animals.**—*Canad. J. comp. Med.* **14** no. 3 pp. 90–108, 5 refs. Quebec, 1950.

An account is given of investigations in Ottawa on the toxicity of parathion administered orally or dermally to laboratory and domestic animals. The following is based on the authors' discussion of the results. The great differences in the total amounts of parathion tolerated and in the survival times of individual rats and mice in long-term feeding trials with parathion food mixtures indicated that the susceptibility of individual animals to parathion varies widely, and this was supported by the results of chronic skin absorption tests in rabbits and by the irregular mortality pattern frequently observed in mice, rats and rabbits after the ingestion of large single doses. However, under the conditions of the experiments, the median lethal dosages for three technical grades of parathion administered orally fell within fairly narrow limits, being 25–38 mg. per kg. for male mice, 21–26 mg. per kg. for rats (predominantly males) and 16–24 mg. per kg. for male guineapigs. The median lethal dosage of 7 mg. per kg. for female rats was an exception to the general trend. Rabbits proved resistant, and the median lethal dosage of parathion in a wettable powder was about 68 mg. per kg. For the other animals investigated, the toxicity levels of the wettable powder did not differ significantly from those of technical parathion. Fowls were more susceptible to both the wettable powder and technical parathion than any other animals except female rats.

Long-term feeding tests with food mixtures containing 100 parts parathion per million also showed the high susceptibility of female rats, but the toxic effect of the mixture was pronounced even in male mice, under nutritional conditions that were obviously more favourable than for rats.

Comparison of the death rates of rabbits in the acute oral and skin absorption tests showed that the dermal toxicity of parathion at fairly high concentrations may be greater than its oral toxicity. The danger incurred by contamination of the skin is further increased by the fact that doses considerably smaller than those lethal in single applications may be fatal on repeated application, the

median lethal dosages for single dermal exposures and multiple exposures (three times a week) being 30 and 6·5 mg. per kg., respectively, for rabbits. The fatal effect of repeated sublethal doses in chronic skin-absorption and feeding tests indicated a cumulative action of parathion, and as it has been shown that the chemical is not stored in the tissues and that it exerts its toxic effect mainly by stimulation of the parasympathetic nervous system through inactivation or destruction of cholinesterase [*cf. R.A.E.*, A **39** 427, etc.], the cumulative action must be regarded as being due to the gradual depletion of this enzyme in the blood stream and tissue fluids.

The results of a few acute oral and skin-absorption tests carried out on sheep and pigs, respectively, suggested that the resistance of large domestic animals to the toxic action may be only moderately higher than that observed in laboratory animals other than the female rat, so that parathion presents far greater hazards of poisoning to domestic animals than DDT, which is toxic but not lethal to cattle, sheep, goats and pigs in oral dosages of approximately 450–1,000 mg. per kg. The fact that the toxic dose of parathion was of about the same order in the different animals suggests that the susceptibility of man will be about the same as that of the animals studied.

Negative results were obtained in all tests in which laboratory animals fed on garden or field crops that had been dusted or sprayed with parathion. The parathion values of all these materials, excepting the potatoes, were determined while feeding was in progress. An exceptionally low residue was found on cabbage, partly owing to the drying of the heads for five days at 54°C. [129·2°F.]. Recent experiments have shown that almost 90 per cent. of the parathion residue may be lost by drying cabbages overnight at 100°C. [212°F.], making it impracticable to use heat in the preservation of materials for experimental purposes, though feeding on heat-treated vegetables or fruit may give useful information regarding parathion residues on processed food.

PAGE (A. B. P.), LUBATTI (O. F.) & RUSSELL (J.). **Application of Fumigants to Ships and Warehouses. VI. Fumigation of dried Fruit with Methyl Bromide in Chambers.**—*J. Soc. chem. Ind.* **68** pp. 102–108, 3 figs., 12 refs. London, 1949.

PAGE (A. B. P.) & LUBATTI (O. F.). **VII. Fumigation of dried Fruit with Methyl Bromide in Chambers.**—*T.c.* pp. 151–158, 7 figs., 2 refs.

CALL (F.). **VIII. Distribution of Fumigants in Chambers fumigated with Ethylene Oxide and Carbon Dioxide.**—*J. Sci. Fd Agric.* **3** no. 5 pp. 212–218, 4 figs., 10 refs. London, 1952.

The first two of these three parts of a series [*cf. R.A.E.*, A **32** 334, etc.] contain accounts of investigations on the large-scale fumigation of dried fruit with methyl bromide in a chamber $50 \times 17 \times 10$ ft. in size having a concrete floor, brick walls and a wooden ceiling, and a loading door at one end. The fumigant was introduced through a copper pipe entering through the ceiling from the loft above.

For the two tests described in the first part, the walls and ceiling were completely lined with bituminous felt, and all joints were made with a bituminous compound. There were three box-type fans, one drawing air through a trap-door in the ceiling, at three corners, for circulating the fumigant, airing or both. Boxes of fruit were stacked on dunnage on the floor, the stacks being 2 ins. apart, and the fumigant was applied at 32 oz. per 1,000 cu. ft. in 17 minutes. In the first test, at a temperature of 19°C. [66·2°F.], the exposure lasted 22·5 hours and was followed by airing with the fans running for six hours, during the first 45 minutes of which the doors were not opened, and for a further 12 hours on the next day, after an overnight period of 9·5 hours with the doors

closed. The fans were kept running for the first six hours of fumigation. In the second, at 18°C. [64·4°F.], the exposure was for 24·5 hours with no stirring of the air during fumigation and was followed by airing with the doors open and the fans running for eight hours, and for a further 12 hours after an overnight period of 12 hours with the doors shut. In raisins, the residues of undecomposed methyl bromide did not exceed 4 parts per million shortly after opening and unloading the chamber, and they fell to 1 p.p.m. after 43 hours of normal airing and to zero after five days. The residues of total bromine did not exceed 7 p.p.m. shortly after unloading, fell to 3 p.p.m. after 24 hours of airing and remained the same after five days. Similar figures were obtained for dates, and slightly lower ones for total bromine in currants and sultanas. In groundnuts, the residues of total bromine were 30–40 p.p.m. soon after unloading and those of undecomposed methyl bromide so low and fugitive as to be harmless.

The distribution of the fumigant and its penetration into the boxes were satisfactory in both tests and only slightly improved by stirring the air. The concentrations in the boxes indicated that a dosage of about 13 oz. per 1,000 cu. ft. for 24 hours or of 32 oz. for 10 hours would be adequate for insect control. Despite the relatively small absorption of methyl bromide by dried fruit, there was a rapid and considerable fall in concentration during the first three hours of fumigation, most of which was probably due to leakage, but determinations of traces of methyl bromide in the air surrounding the chamber showed that these were so small that ill effects on man were unlikely. Determinations round and near the doorway during airing showed that in the first test, when the door was not opened for the first 45 minutes, the rate of airing was too slow, the concentration in the exhaust air at the end of this time being more than 0·3 mg. per litre, which is considered the limit of human safety for short exposures. Five minutes after the door was opened, the concentration in the doorway had fallen to 0·3 mg. per litre ; it remained at about this level for the next hour and then fell to 0·03 mg. in 40 minutes. Concentrations in the loft were very low, showing no appreciable diffusion against the airstream of the fans. In the second test, the concentration was 0·04 mg. per litre after 30 minutes just inside the doorway, but more than 0·3 mg. at a point 5 ft. inside the chamber after 70 minutes, falling to 0·03 mg. after a total of 155 minutes. After the chamber had been aired for eight hours and shut again for 12, the concentration again exceeded 0·3 mg. per litre. It is concluded that the concentration was reduced to a safe value after about two hours' airing with the door open and three fans working. Determinations between the stacks of boxes showed that concentrations were higher there, though not sufficient to cause dangerous concentrations in the main space during unloading.

For the tests described in the second part, the bituminous felt on the walls of the chamber was replaced by a two-inch layer of a mixture of sand, cement and a waterproofing agent, the floor was resurfaced with a similar mixture of fine granite and cement, and the felt on the ceiling was patched and liberally coated with bitumen. In the first, the chamber was treated both empty and full, the exposures being for 12 hours to 22·5 oz. methyl bromide per 1,000 cu. ft. at 13°C. [55·4°F.] and for 22 hours to 32 oz. at 9°C. [48·2°F.], respectively. A punkah was operated for the first 30 minutes when the chamber was empty, but there was no stirring of the air when it was full. Airing was for 3 hours 40 minutes in the first case and 17 hours in the second ; the fans were operated continuously during these periods. There was little loss of fumigant when the chamber was empty, and the concentration fell much more slowly when it was full than in the earlier tests. The distribution seemed satisfactory, and it appeared that replacing the felt walls by cement considerably reduced leakage and absorption. Determinations of methyl bromide in the air showed only a slight trace after airing when the chamber was empty and confirmed that there was little leakage when it was full.

Further tests were carried out after a centrifugal fan had been fitted at the rear end of the chamber to circulate the mixture of fumigant and air, and the methyl bromide was introduced as vapour. The chamber was fumigated empty, or filled with boxes of sultanas stacked with no spaces between and covered at the top and sides with tarpaulins forming a tunnel through which the fumigant was drawn. When empty, it was treated with 30 oz. methyl bromide per 1,000 cu. ft. for 4·75 hours and aired for one hour. When it was loaded, it was fumigated with 32 oz. for 28 hours, followed by ventilation for 2·75 hours and then by alternate circulation of the air in the closed chamber and forced ventilation, repeated three times in 16·5 hours, or with the same dosage for 20·5 hours, followed by airing for 17·5 hours.

The distribution of fumigant in the empty chamber was nearly even from the beginning, and the actual concentration was not much below the nominal one, indicating that circulation was satisfactory even in the absence of a load. In the first test with the chamber full, the distribution was even, but there was a rapid fall in concentration during the first five hours caused by leakage through the ceiling, and the fan was therefore stopped. The rate of loss was then considerably reduced, but it rose again when the fan was restarted 17 hours later, indicating that a more nearly gas-tight chamber is necessary if forced circulation is to be employed. The concentration in the boxes nearly equalled that outside them from 2–4 hours after the beginning of fumigation. With circulation only during vaporisation, distribution was uneven, though penetration into the boxes was satisfactory. This forced ventilation produced much more rapid airing, the concentration in the free space being reduced to 0·05 mg. per litre in less than an hour, and it was evident that, provided that the chamber is adequate, a stirring system of this type ensures rapid, even distribution and penetration in a block of boxes and rapid and thorough airing, with the advantage that the air at the front of the pile, where the boxes are unloaded, is continuously replaced.

In the third part, the author gives the results of investigations on the unevenness of distribution that sometimes results from the common practice of diluting ethylene oxide, used for the fumigation of boxes of dried fruit, with carbon dioxide, to reduce inflammability and increase toxicity. A chamber with a volume of 5,500 cu. ft. and a height of 8 ft. 10 ins. was loaded with boxes of sultanas stacked in tiers to within 18 ins. of the roof, with spaces 2–3 ins. wide between them and a central gangway. For fumigation, 150 lb. solid carbon dioxide was crushed into pieces of 1 cu. in. or less and shovelled evenly over the pile, the chamber was sealed, and 18 lb. of a mixture of ethylene oxide and carbon dioxide (9 : 1) was blown in ; the exposure was for at least 14 hours and was followed by airing for one hour. By this method, the solid carbon dioxide sublimed in 10–12 hours, whereas exposing it on trays suspended from the roof resulted in the sublimation of only about a third and in the dripping of condensed water from under the trays on to the boxes. Air samples taken at intervals showed that after 15 minutes, the concentration was about 50 mg. per litre at the top of the pile and halfway down, but only 13 mg. at floor level. The concentration fell steadily and normally in the upper parts, but there was less drop at floor level, and the distribution throughout the chamber did not become uniform, at about 8 mg. per litre, until nine hours after the beginning of fumigation. The low concentration at floor level resulted in a reduced rate of penetration into the lower layers of fruit, which probably did not receive an adequate dosage.

These results were confirmed when the fumigation was repeated with 21 lb. of the mixture and 150 lb. solid carbon dioxide ; the zone of low concentration of ethylene oxide at the floor was apparently very shallow at first and spread gradually upwards. The concentration of carbon dioxide was initially more than three times as great at floor level as at the top of the pile. The initial

temperature was about 52°F., but there was a slight drop at the top of the pile and a very pronounced fall to 36°F. at floor level, where the temperature did not reach the level of that at the top of the pile for 18 hours. Sharply defined thermal layering evidently took place, leading to the formation at floor level of a stable layer of cold air with a high content of carbon dioxide. A considerable amount of the liquid ethylene oxide applied falls to the floor, and since its boiling point is 53·4°F., evaporation of this is very considerably retarded, so that it is not available for fumigation, at least in the early stages. When a punkah swinging through an arc of about 14 ft. and clearing the floor by 4 ins. was hung in the central gangway, and the second fumigation was repeated with the punkah operated for one hour after the doors were closed, there was a marked improvement in the distribution of the ethylene oxide, the concentration being almost uniform after an hour. The concentration of carbon dioxide was about 50 per cent. higher at floor level than at the top of the pile for the first hour, but had become uniform after three hours. The stirring caused higher concentrations of ethylene oxide in the boxes both on the floor and at the top of the pile ; those on the floor received a satisfactory dosage. Although the floor temperature dropped rapidly from 50 to 38°F. on introduction of the solid carbon dioxide, recovery was almost as rapid, and the floor temperature reached 48°F. 30 minutes after the beginning of fumigation and was thereafter never more than 1° below that at the top of the pile. When a centrifugal fan was fitted, with or without various systems of ducts to direct the air flow, layering was rapidly overcome, but the fan used was less effective than the punkah. An airflow of about 250 cu. ft. per minute was the least that ensured satisfactory stirring.

BLACKITH (R. E.). **Stability of Contact Insecticides. I. Ultra-violet Photolysis of the Pyrethrins.**—*J. Sci. Fd Agric.* **3** no. 5 pp. 219–224, 1 graph, 12 refs. London, 1952. **II. Protection of the Pyrethrins against ultra-violet Photolysis.**—*T.c.* pp. 224–230, 1 graph, 10 refs.

Under certain conditions, the pyrethrins have proved too unstable even for the transient control of agricultural pests normally kept down by natural enemies, and discrepancies have been observed in the persistence of films of pyrethrum in oil in direct and diffused sunlight. In the first part of this paper, tests are described in which filter papers were impregnated with 0·2–2 per cent. pyrethrins in a heavy white-oil solvent and stored in the dark under various conditions or subjected to irradiation with visible or ultra-violet light for up to 10–25 minutes [*cf. R.A.E.*, A **36** 168]. Assays against adults of *Calandra granaria* (L.) showed that ultra-violet photolysis inactivated the pyrethrins more rapidly than the other known natural processes, and that its action was proportional to the period of irradiation and independent of initial concentration, humidity or the presence of oxygen. In the absence of light, the films retained their toxicity for considerable periods ; decomposition appeared to be proportional to the time for which they were stored and was independent of temperature over the normal range.

The second part contains the results of experiments in which attempts were made to protect the films against the action of ultra-violet light by the addition of dyestuffs absorbing in the ultra-violet region or of synergists such as piperonyl butoxide, which has been claimed to stabilise pyrethrins against light and oxidation by the air. When films of 1 per cent. pyrethrins in petroleum ether and heavy white oil (8 : 2), with or without the addition of the dye, benzeneazo-β-naphthol, were irradiated with ultra-violet light and compared against *C. granaria*, the results showed that the protective effect of the dye was good at concentrations of 1 per cent. or more, decreased rapidly at concentrations below 0·5 per cent., possibly owing to lack of coverage, and disappeared at 0·05 per cent. The dye itself had no effect on the weevil. After

exposure to direct sunlight for 70 minutes, biological assay showed that the concentrations of pyrethrins remaining on papers impregnated with 1 per cent. pyrethrins in oil, alone and with 1 per cent. of the dye, were 0·22 and 0·79 per cent., respectively, the amount of protection indicating that the length of life of pyrethrins in an oil film is approximately doubled by the addition of an equal weight of the dye. Comparison with the previous results showed that the decomposition of pyrethrins in strong sunlight takes place mainly, though perhaps not wholly, as the result of photolysis by ultra-violet light. In similar tests, the synergists, piperonyl butoxide, sesamin, isobutylundecyleneamide and piperonyl cyclonene did not significantly protect pyrethrins against ultra-violet photolysis, and it is considered that the earlier report of protection by piperonyl butoxide was based on observations made under conditions that did not permit distinction between synergistic and stabilising effects.

PARKER (H. L.), BERRY (P. A.) & SILVERIA (A.). **Vegetable Weevils and their natural Enemies in Argentina and Uruguay.**—*Tech. Bull. U.S. Dep. Agric.* no. 1016, 28 pp., 8 figs., 3 refs. Washington, D.C., 1950.

In the course of a search in Argentina and Uruguay in 1942–45 for natural enemies suitable for introduction into the United States against *Listroderes obliquus* Gylh. [*cf. R.A.E.*, A **36** 97], it was found that several species and races of *Listroderes*, including *L. obliquus*, occurred in those countries, but were not important pests of vegetables ; the only record of damage was the destruction of a field of young sprouting potatoes in Uruguay by the adults. The larvae fed principally on chickweed (*Stellaria media*). Oviposition and larval development took place throughout the winter, from April to November, and the summer was passed in the adult stage. Parasites bred from the larvae comprised *Porizon parkeri* Blanch., an unnamed species of *Triaspis*, and *Epiplagiops littoralis* Blanch. from both countries, *P. argentinensis* Blanch., a species of *Myiophasia* (*Pseudoclista*) near *aira* (Br. & Berg.), an unidentified species of the tribe Thersilochini and a nematode, from Argentina only, and the entomogenous fungi, *Empusa* (*Entomophthora*) *sphaerosperma* and *Beauveria globulifera*, from both countries, and those from the adults, an unnamed species of *Microctonus*, *Euoestrophasia aperta* (Br. & Berg.) and *Clistomorpha* (*Hyalomyodes*) sp., all from Argentina. *Porizon* spp., *Epiplagiops* and *Triaspis* accepted larvae of any of the species of *Listroderes* for oviposition in the laboratory.

Accounts are given of the appearance of the various stages and the bionomics of *Porizon* spp., *Triaspis*, *Epiplagiops* and *Microctonus*, with brief notes on the other species. When *P. argentinensis* occurred together with *P. parkeri*, records for the immature stages of the two species could not be separated. Only *Porizon*, *Epiplagiops* and the nematode gave important control, the first two together effecting 74, 27, 16 and 6 per cent. parasitism at Santa Fe, Argentina, in 1942, 1943, 1944 and 1945, respectively, and all three together 30, 44 and 33 per cent. in Uruguay in 1943, 1944 and 1945. The nematode was widely distributed, but was important only in restricted localities.

The two species of *Porizon*, *Triaspis* and *Epiplagiops* were imported and released in infested fields in California [*cf. loc. cit.*], but are not known to have become established. Difficulty was experienced in breaking the aestivating diapause of the *Porizon* adults to adapt them to the seasonal rhythm of the northern hemisphere, and *Epiplagiops* evidently required an alternative host during the summer.

LLOYD (D. C.). **A Survey for Grasshopper Parasites in temperate South America.**—*Canad. Ent.* **83** no. 9 pp. 213–230, 1 map, 3 figs., 27 refs. Ottawa, 1951.

A survey of parasites of grasshoppers was made in Uruguay and Argentina during 1943–49 in connection with work on the biological control of grasshoppers

in Canada, and an account is given of the investigations, including descriptions of the topography and climate of the area, an account of the collecting and rearing methods adopted, and lists of the most abundant grasshoppers present, with notes on the importance of some, and of the Dipterous parasites recorded from species of the genus *Dichroplus*, which includes the grasshoppers of greatest economic importance in the area.

Rearing was carried out at 24 centres, and about 320,000 examples of *Dichroplus* spp. and 40,000 of the *Scyllinops* complex were examined ; the parasites reared from them are listed by locality and the parasitism percentages for the Diptera are shown in tables. The latter were based on an estimated emergence of two larvae per host, but 1–10 larvae of the various Sarcophagids develop in a single grasshopper. The maximum percentage parasitism by Diptera of any seasonal sample from a centre was 8·1, and parasitism was in general much lower, though it ranged in smaller collections up to 25 per cent.

The parasites reared comprised eight Sarcophagids, two Nemestrinids of the genus *Neorhynchocephalus* and several unidentified Mermithids. Of the Sarcophagids, *Protodexia australis* Blanch., from both countries, and a species of the same genus from Argentina that was to be described by Blanchard as *P. liebermanni* predominated, effecting at least 80 per cent. of the parasitism recorded ; they were followed in importance by *Tephromyiella neuquenensis* Blanch. and *Sarcophaga* (*Acridiophaga*) *caridei* Brèth., both from Argentina. These four species were each reared from the adults of several species of *Dichroplus*, *T. neuquenensis* and *S. caridei* also from adults of the *Scyllinops* complex, and *S. caridei* from those of *Schistocerca cancellata* (Serv.), while the two species of *Protodexia* were occasionally reared from fifth-instar *Dichroplus* nymphs. The Nemestrinids occurred in both countries, but were usually rare, and the Mermithids, which were found in Uruguay only, were not generally common, though indications were obtained that they might be more important locally than all the Diptera together.

The four principal parasites have similar bionomics. The gravid females deposit larvae, which are naked in *T. neuquenensis* and *S. caridei* and enclosed in the chorion in *P. australis* and *P. liebermanni*, on the abdomens of the hosts 12–16 days after mating. The total number produced per female was 40–80, except in *S. caridei*, in which it ranged up to 100. Development takes place within the body cavity of the host, the larval stage lasting 15–18 days and total development about 4–5 weeks. Normally, only one larva of *S. caridei* completed its development in a host, and up to three of the other species. Examples of *Dichroplus* not infrequently contained 4–5 parasite larvae, however, and the observed maxima for *P. liebermanni*, *T. neuquenensis* and *P. australis* were 10, 7 and 6, respectively ; the adults that develop from such larvae are stunted and probably do not reproduce. The adult parasites survived for 4–5 weeks. In the cooler regions, there was one complete and a partial second generation each year, but in warmer ones, the second generation of *P. australis* is practically complete. Characters differentiating the mature larvae and puparia of the four species are described and illustrated in figures.

During the investigations, consignments containing a total of over 11,000 mature larvae and puparia of the principal parasite species were forwarded by air to Canada. All except a few lots of *S. caridei* that were subjected to excessively low temperatures prior to dispatch arrived in good condition [*cf.* **39** 89]. Four lots comprising 700 larvae and puparia of four Canadian Sarcophagid parasites of grasshoppers were sent to Argentina, but owing to delays in transit, only 67 larvae of *Sarcophaga reversa* Aldr. arrived in good condition, and a laboratory stock could not be built up.

It is concluded that the complex of parasites attacking *Dichroplus* in South America is broadly similar to that attacking *Melanoplus* in Canada [**32** 297 ;

35 59], their importance slight and their potential value for introduction into North America therefore low.

THOMPSON (W. R.). **The Time Factor in Biological Control.**—*Canad. Ent.* **83** no. 9 pp. 230–240, 5 refs. Ottawa, 1951.

The author discusses Clausen's conclusion, based on field observations, that, subject to certain qualifications, an introduced insect parasite or predator that is capable of exerting commercial control of a pest, will do so within three generations or, at most, three years [*R.A.E.*, A **39** 262] in the light of his own hypothesis, based on mathematical computations, regarding the period likely to elapse before control is effected [**15** 239, etc.]. He shows that there is less divergence between the two views than might be supposed, and that some aspects of Clausen's conclusion can be explained mathematically. He points out, however, that where a parasite with a low reproductive rate is liberated in numbers that are low in relation to those of the host, it can be shown that the proportion of parasitised hosts over the whole area will remain low for a very considerable period and then increase suddenly and rapidly to an effective level ; during the period of low parasitism local concentrations of parasites, and, in consequence, locally high parasitism, may occur. On the other hand, a parasite may fail to exert ultimate control for reasons unrelated to its reproductive rate, such as the inaccessibility of a proportion of the hosts in each generation. The qualities requisite in a parasite to enable it to exert commercial control are not frequently combined in one species, and in nature an organism is held in check rarely by any one parasite or predator, and usually by a combination of physical and biotic factors ; the latter may include a complex of parasites attacking their host in different stages or microclimates and each exerting only a low degree of control by itself.

The author nevertheless considers that insufficient weight has in the past been laid on the value of the sequence of events in the vicinity of a liberation site during the first few years after release as an indication of final effectiveness.

HENSON (W. R.). **Mass Flights of the Spruce Budworm.**—*Canad. Ent.* **83** no. 9 p. 240, 2 refs. Ottawa, 1951.

During an investigation in Canada on the dispersal of *Choristoneura fumiferana* (Clem.), 19 mass flights of the moths were observed in detail. All took place in the evening or early part of the night. A cold frontal passage followed settling, and in some cases there were periods of rainfall, usually brief, before the flights. From a consideration of the meteorological conditions, it is concluded that the moths were carried by the convective storms that precede typical cold fronts. Sudden thunderstorms that reduce the amount of light and bring about pressure changes are known to result in heavy flights of moths, and prefrontal thunderstorms probably initiate the mass flights of *C. fumiferana*.

WOOD (G. W.). **An annotated List of Lepidopterous Larvae from commercial Blueberry Fields, Charlotte County, N.B.**—*Canad. Ent.* **83** no. 9 pp. 241–244. Ottawa, 1951.

Following the outbreak of *Actebia fennica* (Tauscher) on cultivated blueberry in New Brunswick in 1944–45 [*cf. R.A.E.*, A **38** 399], Lepidopterous larvae were collected in representative fields in Charlotte County in 1946–50. A list is given of the 38 species represented, showing the dates of collection, pupation and adult emergence, in some cases (based on light-trap records) the duration of adult flight, and the parasites reared.

THOMPSON (W. R.). **The Specificity of Host Relations in predacious Insects.**—*Canad. Ent.* **83** no. 10 pp. 262–269. Ottawa, 1951.

The author discusses the relative advantages of parasites and predators as agents of biological control and points out that one factor contributing to efficiency is host specificity. Many parasites are known to show a high degree of specificity, but predators are commonly thought not to do so. Evidence was obtained, however, during the attempt to control *Carulaspis* (*Diaspis*) *visci* (Schr.) on *Juniperus bermudiana* in Bermuda, by means of introduced Coccinellids [*R.A.E.*, A **38** 85 ; **39** 148], that they are more specific than generally supposed. Before the attempt was begun, it was thought that almost any Coccinellid that feeds on Diaspines could be introduced with satisfactory results, since alternative hosts would be uncommon. During 1947–48, some 13 species were imported from various parts of the world ; two of them had been recorded attacking *C. visci*, and in a preliminary test, these and seven others bred freely when confined in bags on infested branches. Large-scale releases were accordingly made, but only *Lindorus lophanthae* (Blaisd.) became established [**39** 148]. Since *C. visci* is abundant throughout the year and it is unlikely that climate, interference by natural enemies or inaccessibility of the Coccids was responsible for the failure of the others, it is concluded that host specificity was the cause.

The author also points out that predacious Coccinellids may not feed habitually on all the insects with which they are observed in association. An example of a high degree of specificity to environment in a predator is provided by *Orcus chalybeus* (Boisd.), one of the species introduced into Bermuda. It was distributed some years ago over an area about 250 miles long in southern California, but is now present only in two areas there that are apparently more humid than the rest and occasionally occurs in considerable numbers in *Citrus* orchards [*cf.* **37** 288].

PATERSON (J. J.) & SHANKS (G. L.). **The Effects of Weed and Insect Sprays on Spraying Equipment Materials.**—*Sci. Agric.* **32** no. 4 pp. 190–203. Ottawa, 1952.

The effects of some recently developed insecticides and weed-killers on materials used in the construction of spraying equipment was investigated in Manitoba in 1949–51. Small strips of metal and of galvanised iron or steel coated with non-metallic substances or with paint, and tubing made of metal, rubber or a synthetic material were suspended in the spray mixtures so that they were half, or in the case of the rubber tubing, wholly immersed and left for about seven weeks. The insecticides tested were aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and chlordan, all at concentrations well above those at which they are likely to be used in practice. The results are given in tables. Aldrin, and to a less extent dieldrin, caused some damage to iron, zinc, aluminium, coatings of asbestos and Permolite (a pigmented modified phenolic air dry coating) and certain paints ; chlordan also attacked the metals, but had relatively little effect on most paint coatings. Iron, zinc and aluminium seemed more liable to attack than other metals, and paint coatings applied by brush were less resistant than baked ones. Immersion of the samples for one month was found to be long enough for any effects to become apparent.

The authors recommend that spraying machines that have been used for these materials should be thoroughly flushed out and that unused spray liquids should not be left in them for long, especially if they are in contact with

galvanised iron or aluminium. After flushing at the end of the season, all parts should be drained as completely as possible. Iron should not be used in the construction of spray equipment unless it is covered with a metallic or paint coating. Where paint coatings are used, they should be of the baked type, especially on parts in contact with the spray.

HARCOURT (D. G.), MATTHEWMAN (W. G.), CASS (L. M.) & FRIEND (W. G.). **Tests of various Insecticides against the Cabbage Maggot attacking Radish, 1948–1950.**—*Sci. Agric.* **32** no. 4 pp. 214–218, 4 refs. Ottawa, 1952.

Mercuric chloride (mercury bichloride) and mercurous chloride (calomel) are commonly recommended against *Hylemyia* spp. in the roots of crucifers in Canada, but have proved unsatisfactory on radish. More recent materials were therefore compared with them in tests at Ottawa in 1948–50. The insecticides were applied twice at an interval of ten days as drenches poured along the plant rows at a rate of 1 gal. per 40 ft. or as dusts at an average rate of 13 oz. per 100 ft. to radish in experimental plots in which *H. brassicae* (Bch.) was the most injurious species and *H. cilicrura* (Rond.) and *H. trichodactyla* (Rond.) were also present. The best materials, in order of decreasing effectiveness, were wettable powders containing 50 per cent. BHC [benzene hexachloride], 50 per cent. heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], 25 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], 25 per cent. lindane [containing at least 99 per cent. γ BHC] and 15 per cent. parathion at concentrations of 3, 3, 4 and 0·75 lb. in 80 gals. and 2 lb. in 100 gals., respectively, a BHC dust containing 0·5 per cent. γ isomer, wettable powders containing 50 per cent. chlordan and 25 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and a dust containing 2 per cent. parathion ; the control obtained ranged from 83 to 66 per cent. A chlordan dust, drenches of mercuric chloride, Dilan [a 2 : 1 mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane] and Karathane [dinitrocaprylphenylcrotonate], and dusts and drenches of mercurous chloride, toxaphene, DDT, DDD [dichlorodiphenyldichloroethane] and methoxy-DDT (methoxychlor) were unsatisfactory. The BHC, toxaphene and DDT dusts and the BHC drench were strongly phytotoxic and the toxaphene drench slightly so. In addition, BHC and, to a less extent, lindane, tainted the radishes.

The chlorinated hydrocarbons and parathion are not recommended for use, since radishes mature so rapidly that in a schedule of two applications, the second has to be made only a few days before harvest, but radish is a very suitable crop for tests against *Hylemyia*.

BRADLEY (R. H. E.) & GANONG (R. Y.). **Aphid Infestations on Katahdin and on a Seedling resistant to *Myzus persicae* (Sulz.), with two Dates of Planting.**—*Canad. J. Zool.* **29** no. 6 pp. 329–338, 5 graphs, 4 refs. Ottawa, 1952.

During investigations in the last ten years on Aphid resistance in potatoes in New Brunswick, the variety Katahdin, which is widely grown in eastern Canada, consistently supported some of the heaviest populations of *Myzus persicae* (Sulz.) and was used as a standard. B294–85, a seedling from the United States, showed promises of resistance and investigations were made in 1950 to ascertain whether this would be maintained in the field. The following is based on the authors' summary of the results. In field tests in August, the numbers of *M. persicae* present per plant in early planted plots were usually over five times as great on Katahdin as on B294–85, and those of *Aphis rhamni* Boy. (*abbreviata* Patch) were over ten times as great. The differences in the

Aphid populations on late planted plots of Katahdin and B294–85 were similar, but not so great. There were no consistent differences in the numbers of *Macrosiphum solanifolii* (Ashm.) on Katahdin and on B294–85. During August, the rates of increase of each species were similar for both varieties and dates of planting. The number of Aphids per plant was many times greater on the early planted than on the late planted potatoes, the differences being greater for Katahdin than for B294–85. When the populations were expressed as numbers of Aphids per unit leaf area, the distribution of each species on the top, middle and bottom leaves was similar in all cases.

BLAIS (J. R.). **The Relationship of the Spruce Budworm (*Choristoneura fumiferana*, Clem.) to the flowering Condition of Balsam Fir (*Abies balsamea* (L.) Mill.).**—*Canad. J. Zool.* **30** no. 1 pp. 1–29, 1 pl., 7 figs., 11 refs. Ottawa, 1952

The following is virtually the author's summary. Populations of *Choristoneura fumiferana* (Clem.) were studied on flowering and non-flowering balsam fir (*Abies balsamea*) in north-western Ontario in 1946–50. More eggs were generally found on the flowering trees, and the latter harboured higher populations in the early larval stages, owing to the presence on them of staminate flowers and flower scars. The behaviour of the larvae in relation to staminate flowers and flower scars was studied in both the field and the laboratory. Larvae that fed partly on pollen developed more rapidly than larvae that fed exclusively on foliage, but pollen as a food did not appear to have any direct effect on survival or fecundity [*cf. R.A.E.*, A **38** 194 ; **39** 1, etc.]. Other experiments showed that mortality was higher, development retarded and fecundity reduced in insects forced to feed on old foliage, as compared with those that fed on the current year's growth. Defoliation was more severe on flowering trees in the earlier stages of the infestation. However, as populations increased, the wandering of the larvae increased owing to competition for food. This resulted in an overflow of larvae from flowering to non-flowering trees.

STEPHENS (J. M.). **Disease in Codling Moth Larvae produced by several Strains of *Bacillus cereus*.**—*Canad. J. Zool.* **30** no. 1 pp. 30–40, 1 pl., 1 graph, 9 refs. Ottawa, 1952.

In 1947, larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) in a laboratory stock maintained at Belleville, Ontario, in connection with the rearing of parasites were attacked by a disease caused by *Bacillus cereus*. It was most prevalent among overwintering larvae in corrugated cardboard strips. In the course of studies on it, 11 strains of *B. cereus* were isolated from apples and larvae of *C. pomonella* from different parts of Canada and larvae from the United States, and one that may have been *B. megatherium* from apples in Ontario. Descriptions are given of their morphology, cultural and physiological characters, and antigenic properties. One of the strains of *B. cereus* was reared from larvae collected in the Niagara district and may be the one previously reported from that area [*R.A.E.*, A **30** 112].

In tests on pathogenicity, 1 ml. of a 24-hour broth culture injected intramuscularly into rabbits and guineapigs had no effect, but similar amounts injected intraperitoneally killed white mice in 6–48 hours. When 0·01 ml. of suspensions of the various strains was injected into larvae of *C. pomonella* in the region of the fifth abdominal segment, death followed in 24–48 hours ; 10 of the 12 strains gave 70–100 per cent. mortality, and the bacteria were recovered in pure culture from all the dead larvae. In feeding tests, larvae in the fourth or early fifth instars were sealed into cavities in the pulp of apples into which a drop of bacterial culture had been allowed to soak ; each drop

contained about a million bacteria, but not all these were ingested. The larvae showed symptoms, which are described, after 24–72 hours, and the percentage mortality from the twelve strains ranged from 20 to 75 and averaged 55, as compared with 1·5 in the controls. Most of the strains isolated from insects were more virulent than those from apple ; one, the original culture of which gave 40 per cent. mortality, gave complete kill after three passages through larvae.

Strains of *B. cereus* can readily be propagated in the laboratory on artificial media and they survive for a long period as spores. They can be applied as sprays or dusts in a peat carrier in the field by means of commercial equipment.

CHATTERS (R. M.) & SCHLEHUBER (A. M.). **Mechanics of Feeding of the Greenbug (*Toxoptera graminum* Rond.) on *Hordeum, Avena,* and *Triticum*.**—*Tech. Bull. Okla. agric. Exp. Sta.* no. T-40, 18 pp., 13 figs., 4 refs. Stillwater, Okla., 1951.

Observations were made in Oklahoma on the feeding habits of *Toxoptera graminum* (Rond.) on 11 varieties of wheat, seven of barley and one of oats, in order to determine the cause of resistance or susceptibility to the Aphid [*cf. R.A.E.*, A **34** 375]. There was no relation between amounts of mechanical tissue in the leaves or young stems of wheat or barley and susceptibility or resistance. A preliminary study on barley indicated that resistant varieties had thicker leaves than susceptible ones, but there was no correlation between numbers of stomata on the leaf surface and resistance.

Examination of microscope slides prepared to show the mode of entry of the stylets into the plant indicated that they penetrated intercellularly and were directed with marked precision. The phloem appeared to be the principal site of feeding, but injection of saliva and not actual feeding was apparently the principal cause of injury. Barley, oats and wheat reacted differently to attack, suffering chemical lysis, cell-wall modification and a combination of the two, respectively. The numbers of stylet sheaths in the tissue served to indicate the amount of damage and tended to increase geometrically rather than arithmetically with an increase in Aphid population.

If structural differences account for resistance, this would be related to the leaf thickness and length of the extended stylet, but there is insufficient evidence to substantiate such a hypothesis. The results obtained indicate that resistance and susceptibility to *T. graminum* are expressions of physiological differences.

SUNESON (C. A.) & NOBLE (W. B.). **Further Differentiation of Genetic Factors in Wheat for Resistance to the Hessian Fly.**—*Tech. Bull. U.S. Dep. Agric.* no. 1004, 8 pp., 10 refs. Washington, D.C., 1950.

A breeding programme was begun in 1936 to develop a strain of wheat resistant to the strain of the hessian fly [*Mayetiola destructor* (Say)] prevalent in the vicinity of Rio Vista, California [*cf. R.A.E.*, A **32** 10, etc.]. Between 1944 and 1946, two derived resistant varieties, Poso 42 and Big Club 43, obtained from crosses and back crosses between the original Poso and Big Club varieties and Dawson, became generally adopted throughout the area, and natural infestation fell to a low level. Since it was insufficient to permit further study of the genetic aspects of resistance, the work was terminated and the results obtained in 1938–44 are here presented.

NICKELS (C. B.), PIERCE (W. C.) & PINKNEY (C. C.). **Parasites of the Pecan Nut Casebearer in Texas.**—*Tech. Bull. U.S. Dep. Agric.* no. 1011, 21 pp., 7 figs., 3 refs. Washington, D.C., 1950.

Acrobasis caryae Grote is the most injurious insect pest of pecan in Texas, and a study of its parasites was made there in 1929–34. The results are presented

in this bulletin, together with those obtained by earlier workers, and 26 primary and 5 secondary parasites are recorded, with information on the bionomics and effectiveness of the more important.

The only parasite of the eggs was *Trichogramma minutum* Ril., which emerged from 18, 11 and 8 per cent. of those of the first, second and third generations collected in 1930. It was reared in the laboratory on *Sitotroga cerealella* (Ol.), in which development lasted 86 and 42 days when oviposition occurred in November and February, respectively, and was released on pecan trees in 1930–32, together with strains originating from Arizona, Georgia and Louisiana. Although as many as 50,000 parasites were liberated per tree in some tests, effective control was not obtained.

Of the other parasites, all those of importance were reared from the larvae, total parasitism of which in 1929–34 averaged 11 and 21 per cent. for individuals overwintering in hibernacula and in shoots, respectively, 31 per cent. for the first generation and 15 per cent. for the second and third. The Braconids, *Apanteles epinotiae* Vier., *Agathis* (*Bassus*) *acrobasidis* (Cushm.), *Macrocentrus instabilis* Mues. and *Orgilus maculiventris* (Cress.), were solitary internal parasites, overwintering as immature larvae within the body of the host larvae. Like their host, *Agathis*, *Macrocentrus* and *Orgilus* have 2–4 generations a year, but *Apanteles* has more, the adults emerging almost continuously throughout the season. Development in summer lasted about 15 days for *Apanteles*, 31–36 days for *Agathis*, and 28 days for *Macrocentrus*. All generations of *Acrobasis* were attacked, but parasitism of the first was the highest.

Another Braconid, *Bracon* (*Microbracon*) *variabilis* (Prov.), also attacked all generations, but parasitism of the overwintering larvae was the highest, and this species was the most important parasite of that generation. Several individuals emerged from single hosts. Development lasted 19–23 days in April–May, but overwintering larvae occurred in each generation of the host. They were commonest in the first. *Euderus* (*Secodella*) *acrobasis* Cwfd., a solitary external parasite, was reared only from larvae overwintering in hibernacula. Full-fed larvae of this Eulophid collected early in February pupated in March and gave rise to adults in late March and early April.

The Ichneumonid, *Ephialtes* (*Calliephialtes*) *grapholithae* (Cress.) was reared as a primary parasite from *Acrobasis* and as a secondary parasite from *Agathis acrobasis*. It attacked overwintering and first-, second- and third-generation larvae of *Acrobasis*, but the percentage parasitism was low, though variable. Development lasted 16 days in September and 18·5 in October.

Perisierola cellularis var. *punctaticeps* (Kieff.), an external Bethylid parasite, probably overwinters as an adult in central Texas. It was reared from overwintering and first-, second- and third-generation larvae. Eggs were laid on the body of the host, 1–18 on a single larva, though five were usually deposited on a fourth- or fifth-instar larva in the orchard. The egg-stage lasted 2–8 days in March and April and about 1·5 days in June–August, when complete development required about 11 days. When more than four larvae developed on one host, the whole contents of the body were sometimes consumed. At temperatures of 80–85° F., the average preoviposition and oviposition periods were 5·7 and about 19 days, respectively, the females survived for 30·7 days and the number of eggs per female was 34·3. The larval feeding period lasted 2–3 days, and total development 11 days. The parasite also attacks *Enarmonia* (*Laspeyresia*) *caryana* (Fitch) (hickory shuckworm), and a technique was developed for rearing it on this host in the laboratory ; more than 25,000 adults were obtained between January and April 1930.

The other primary parasites observed were of less importance, and of the hyperparasites, *Perilampus fulvicornis* Ashm. was the only one reared in large numbers. It emerged from 12, 28 and 34 per cent. of *Apanteles epinotiae*,

Agathis acrobasidis and *Orgilus maculiventris* and 1·4, 0·8 and 5·3 per cent. of *Ephialtes grapholithae*, *Bracon variabilis* and *Perisierola cellularis* var. *punctaticeps* collected in 1929–31.

HUNT (G. M.) & SNYDER (T. E.). **An International Termite Exposure Test—Twentieth Progress Report.**—[*Proc.*] *Amer. Wood-Pres. Ass.* [**45**] preprint 8 pp. [Baltimore, Md.] 1949.

This progress report on the effectiveness of various chemicals in preserving specimens of wood from attack by decay and termites [*cf. R.A.E.*, A **37** 321] contains tabulated data on the condition in 1948 of the specimens installed in 1928, 1929, 1931, 1938, 1940 and 1941 and on that of the last of those installed in 1933, which were removed in May 1947.

SPILLER (D.). **A Study on Control of Infestations of the Common House Borer *Anobium punctatum* De Geer. Part I. Results for the Period 1944–51.**—*N.Z. J. Sci. Tech.* **33** (B) no. 6 pp. 447–459, 2 figs., 6 refs. Wellington, N.Z., 1952.

Infestation of structural timbers by *Anobium punctatum* (Deg.) occurs in almost all houses 15 or more years old in New Zealand, involving the expenditure of large sums. Since little experimental work has been done on control [*cf. R.A.E.*, A **36** 414], studies on the value of the measures commonly employed were begun in 1944. Lightly infested boards, 2–3 ft. long and with exit holes distributed at random, of rimu [*Dacrydium cupressinum*] and kahikatea [*Podocarpus dacrydioides*] and smaller numbers of similar boards of matai [*P. spicatus*] and kauri [*Agathis australis*] were used. Only one half of each board was treated, and the efficacy of the treatment was estimated by comparing the total survival among larvae in the treated halves of a number of replicates with that in the untreated halves. Survival was estimated by marking the exit holes present at the time of treatment and subsequently counting and marking the unmarked ones found at the end of each flight period. The test materials were injected into the exit holes by means of a hand-operated pressure oil gun with a tapered nozzle or brushed over the surface, and both methods were sometimes used.

The following is partly based on the author's summary of the results obtained up to 1951. When power kerosene was applied by means of the gun, larvae survived in pockets in the wood to which the kerosene had not penetrated, and the addition of 10 per cent. o-dichlorobenzene, p-dichlorobenzene or naphthalene, 2 per cent. trichlorophenol or 5 per cent. pentachlorophenol gave no material improvement ; the addition of 10 per cent. dichloroethyl ether gave complete mortality, however, and it is assumed that the vapour diffused into the untreated pockets of wood. In tests with various petroleum-type solvents and creosote applied as single brush coatings, power and lighting kerosene, white spirit (mineral turpentine) and coal-tar creosote all permitted considerable emergence, but gas-oil gave almost complete control over a period of about four years ; much of it was still present 30 months after application, and was distributed throughout the wood. When solutions of 5 per cent. pentachlorophenol, dichloroethyl ether or p,p DDT or 2 per cent. γ BHC (benzene hexachloride) in kerosene were applied in the same way, only the last two gave adequate control throughout the period.

On the basis of these results, heavy surface applications of gas-oil, a cheap and effective remedy, are recommended for sheds and other situations where the staining and slight oiliness caused by it are of no importance. Intensive treatment with 10 per cent. dichloroethyl ether in power kerosene by means of a pressure gun appears effective for furniture and accessible woodwork, but will

not prevent reinfestation, and surface applications of 5 per cent. p,p DDT or 2 per cent. γ BHC in power kerosene appear to be the only satisfactory treatments for other timbers.

SPILLER (D.). **A Note on the Toxicity of Boric Acid to Larvae of the Two-toothed Longhorn** *Ambeodontus tristis* **F.**—*N.Z. J. Sci. Tech.* **33** (B) no. 6 pp. 493–494, 1 graph, 4 refs. Wellington, N.Z., 1952.

Larvae of the native Cerambycid, *Ambeodontus tristis* (F.), frequently damage timber in buildings in New Zealand. As nothing was hitherto known of the effect on them of the preservatives in common use, the results are given of a single determination of the toxicity of boric acid. Newly hatched larvae were transferred to grooves cut in test blocks of *Podocarpus dacrydioides* that had been treated with boric acid by a method already noticed [*R.A.E.*, A **38** 138] and were examined 12 months later. Loadings of 0·092 per cent. or more boric acid were found to be lethal, but loadings of 0·046 per cent. did not prevent survival and growth. The average weight of the larvae declined as the loading increased, however, and by plotting one against the other, a hypothetical minimum toxic loading of about 0·066 per cent. was obtained. The larvae are therefore rather more susceptible to boric acid than those of *Lyctus brunneus* (Steph.) and rather less than those of *Anobium punctatum* (Deg.) [**38** 139].

BUZACOTT (J. H.). *Rhyparida discopunctulata* **Attack on Jute.**—*J. Aust. Inst. agric. Sci.* **17** no. 4 pp. 214–215, 1 fig. Sydney, 1951.

The petioles of ramie (*Boehmeria nivea*) in experimental plots in northern Queensland were extensively attacked in 1947 by adults of the Eumolpid, *Rhyparida discopunctulata* Blkb., though little economic damage was caused. Jute (*Corchorus olitorius* and *C. capsularis*) is now being grown experimentally in the same area. *C. olitorius* has been severely injured by the beetles, but not *C. capsularis*, even though growing in adjoining plots. The beetles on plants of *C. olitorius* two months old varied in number from one to ten. They girdle the petioles of the upper leaves, which are killed, destroy the growing points of the terminal shoots, and cause superficial injury to the capsules. The destruction of the terminal shoot encourages the development of side shoots, which is undesirable in fibre-crop plants. At the time of writing, however, *C. olitorius* appeared less well suited to local conditions than *C. capsularis*.

EVANS (G. O.). **A new Typhlodromid Mite predaceous on** *Tetranychus bimaculatus* **Harvey in Indonesia.**—*Ann. Mag. nat. Hist.* (12) **5** no. 52 pp. 413–416, 2 figs., 3 refs. London, 1952.

Typhlodromus longispinosus, sp. n., is described from females found feeding on *Tetranychus bimaculatus* Harvey on cassava (*Manihot utilissima*) in Indonesia. Examination of the type material of *Typhlodromus thripsi* MacGill [*R.A.E.*, A **27** 672] has shown this species to be a synonym of *T. cucumeris* Oudm.

[FEDOTOV (D. M.).] **Федотов (Д. М.).** Ed. **The Noxious Little Tortoise,** *Eurygaster integriceps* **Put. Reports on the Work of the Expedition to Central Asia for the Study of the Noxious Little Tortoise organised by the A.N. Severtzov Institute of Evolutionary Morphology.** [*In Russian.*] **Vol. 1.**—272 pp., 47 figs., many refs. Moscow, Akad. Nauk SSSR, 1947. Price 20 *rub.* **Vol. 2.**—271 pp., 65 figs. (incl. 1 pl.). many refs. Price 21 *rub.*

This symposium on *Eurygaster integriceps* Put. is based largely on the results of an expedition in 1941–43 to the Provinces of Kashka-Dar'ya (south-western

Uzbekistan) and Frunze (northern Kirghizia) and adjoining districts in southern Kazakhstan. Abstracts of eight of the papers appear below. The remaining five, comprising two by D. M. FEDOTOV (**1** pp. 35–80 ; **2** pp. 49–66), two by A. A. MAKHOTIN (**1** pp. 120–126, 127–135) and one by K. V. ARNOL'DI (**1** pp. 136–269), are extended versions of papers already noticed [*R.A.E.*, A **32** 103 ; **33** 159, 301 ; **34** 48 ; **35** 345].

FEDOTOV (D. M.). **The Work of the A.N. Severtzov Institute of Evolutionary Morphology of the Academy of Sciences of the USSR on the Biology of** *E. integriceps* (**1** pp. 3–9). An outline is given of the work of the expedition, together with summaries of the contents of the other papers.

TRUKHANOV (I. F.). **Contribution to the Morphology of** *E. integriceps* (**1** pp. 10–34, 25 figs.). Descriptions are given of the structure of the wings, the abdomen, the stink glands, the salivary glands, the digestive tract, the Malpighian tubes, the pericardial cells and the nervous, tracheal and circulatory systems of the adults, of *E. integriceps*, and of the male and female genitalia.

TEPLYAKOVA (M. Ya.). **Postembryonic Development of the internal Organs of Reproduction in the annual Cycle of** *E. integriceps* **in the southern European and Asiatic Regions of the USSR** (**1** pp. 81–119, 8 figs.). From dissections of material collected in Uzbekistan in 1942 and in other parts of the Soviet Union in earlier years, the author describes the sexual development of *E. integriceps* from hatching of the nymphs to the death of the overwintered adults. There was a direct relation between the growth of the corpora allata and that of the internal sex organs. Other subjects discussed comprise fecundity, the effect on development of nutrition, temperature and humidity, the importance of the fat-body, the reserves in which become depleted as the sexual organs develop, and the adverse effects of starvation, bacterial and fungous diseases, and parasites and predators.

MAKHOTIN (A. A.). **Materials relating to the Development of** *E. integriceps*. (**2** pp. 19–48, 14 figs. (incl. 1 pl.)). The author describes the eggs and the five nymphal instars of *E. integriceps*, and gives notes on the development of the egg and that of various organs of the nymphs and adults, including the proboscis, antennae, legs, stink glands, and genitalia.

FEDOTOV (D. M.). **The Condition of** *E. integriceps* **during a Period of numerical Depression** (**2** pp. 3–18, 12 figs.). Observations were made in July–September 1945 on the habits and development of *E. integriceps* at various elevations in the Ferghana range in southern Kirghizia, during a period when the bug was declining in numbers. The main site was a neglected strip of wheat densely overgrown with weeds at a height of about 4,600 ft. The behaviour of the bug differed considerably from that observed during the outbreaks in Uzbekistan and northern Kirghizia in 1942 and 1943 [*cf.* **35** 345]. Wild grasses were almost its only food-plants, development was retarded and the successive stages overlapped. In these respects *E. integriceps* resembled other Pentatomids present that do not increase to outbreak numbers.

Dissections revealed a low level of vigour. Both old and young adults contained small fat-bodies and little food in the intestine, the productiveness of the ovaries was low, and the stink glands gave off only a faint odour. Of the young adults, 23 per cent. were attacked by unidentified Hymenopterous parasites and of the overwintered adults, 16 per cent. contained larvae of Phasiine Tachinids [*cf.* **33** 301 ; **36** 241], though many of the latter were dead ; this was apparently due to the poor state of nourishment of the hosts. Young adults taken in the first half of August remained alive and active for a month in a cage when provided with suitable fresh green food. There was little mortality, and the condition of their internal organs, as shown by dissection, indicated that metabolism and other functions continue almost normally for at least a month after adult emergence and that aestivation can be retarded by

suitable environmental conditions. Males predominated among the young bugs at the time of aestivation, which was indicative of a decline in population.

CHERNOVA (O. A.). **New Data on the Morphology and Fecundity of the Dipterous Parasites of** *E. integriceps* (**2** pp. 67–74, 6 figs.). The parasites of *E. integriceps* dealt with are the Phasiine Tachinids, *Helomyia lateralis* (Mg.), *Alophora subcoleoptrata* (L.) [*cf.* **33** 301], a species of *Gymnosoma* (*Rhodogyne*) differentiated and named *R. clavatum* by Rodendorf in the following paper, and *Phasia crassipennis* (F.), all from northern Kirghizia and the first three also from other parts of the Soviet Union. The eggs of all of them and the reproductive organs of the females of the first three are described. *H. lateralis* is the most important, as it is almost specific to *E. integriceps* and has a high fecundity. Dissections showed up to 150 eggs in the two ovaries, so that the number laid might range up to 300 per female. The fecundity of *A. subcoleoptrata* appeared to be moderate only, and though its distribution coincides with that of *E. integriceps*, its common occurrence throughout southern Europe and Central Asia indicates that it also parasitises other Pentatomids [*cf.* **33** 302]. *G. clavatum* belongs to a group of Tachinids the fecundity of which is moderate, and it probably attacks other Pentatomids when *E. integriceps* is scarce. The record of *P. crassipennis* is based on an egg observed on a female of *E. integriceps* taken in June 1943 ; it resembled that figured by Vasil'ev [*cf.* **1** 448]. This species also probably attacks more than one host, and its reproductive rate is not great.

RODENDORF (B. B.). **A short Guide for the Identification of Dipterous Parasites of** *E. integriceps* **and other Pentatomidae** (**2** pp. 75–88, 13 figs.). Keys are given to the adults of 28 species of Tachinids that parasitise Pentatomids, including *E. integriceps*, in the Soviet Union or elsewhere, showing the hosts and distribution of many of them, together with notes on the characters employed in diagnosis.

PEREDEL'SKIĬ (A. A.). **Biological Foundations of the Theory and Practice of the Control of** *E. integriceps* (**2** pp. 89–270, 2 figs.). The first part of this paper (pp. 89–158) contains notes on the history of the study of the genus *Eurygaster* and a survey of the geographical distribution of 15 species of it, *E. integriceps* being dealt with in detail. Further lists show the areas in which *Eurygaster* spp. and other Pentatomids have been recorded as injurious to cereals. Outbreaks of cereal bugs that have occurred in the Soviet Union and other countries since the late 19th century are reviewed, and the factors responsible for their occurrence and decline are discussed. The complexity of the conditions that affect the dynamics of these bugs is emphasised, and it is pointed out that forecasts should not be based on one of them only. The literature on the biology and ecology of cereal bugs, the damage caused by them, and the various mechanical, agricultural, chemical and biological measures of control is reviewed in further sections.

In the second part of the paper (pp. 158–250), the biology of *E. integriceps* as observed in south-western Uzbekistan (Province of Kashka-Dar'ya) in 1941–42 and in northern Kirghizia (valley of the Chu) in 1942–43 is discussed. It was found that the life-cycle consists of five phases, of which three are active and two inactive. The first active phase begins in spring when the nymphs reach the second instar and lasts until the young adults fly from the grain fields to their summer-autumn aestivation quarters, where the first inactive period is passed. The second active phase occurs in autumn, when the bugs move from their aestivation sites to their hibernation quarters, and lasts until the onset of cold weather. Hibernation constitutes the second inactive phase and is followed by a resumption of activity in spring (third active phase) [*cf.* **33** 159], when the bugs feed, pair and oviposit. It is terminated by the death of the overwintered adults. Behaviour was affected by climatic conditions. The

seasonal migrations were conditioned by temperature and humidity, and migrations to higher altitudes occurred only during the search for aestivation sites [*cf.* **32** 103] ; all other migrations were to the same or lower elevations. In spring, the overwintered adults descend in waves from the mountains to the plains, where they are favoured by dryness and warmth. As the season progresses, the waves of migrating bugs stop higher up, and those at the greatest heights, being the latest to resume activity, remain where they are, probably because of the absence of meteorological stimuli inducing flight to lower levels. These bugs form the reserve of the population. The migrations of the young adults for aestivation and hibernation were also conditioned by temperature and humidity preferences. Variations in the sex ratio between the end of March and the beginning of July are shown in a table and discussed, and lists are given of the plants on which feeding or oviposition was observed [*cf.* **33** 301]. Food preferences varied with the character and composition of the plant community, and cultivated cereals did not always attract the bugs from wild plants, even when closely intermixed in the same fields. For control, wild food-plants should be destroyed in fallow land rather than in fields and hibernation quarters, and before the nymphs have reached the second or third instar.

The observations showed four types of distribution in cultivated fields. The bugs were fairly evenly distributed in spring, during the migration to the fields and at the beginning of the oviposition period, but as most of the eggs were laid on weeds, distribution later became patchy. The nymphs also occurred in patches during the first three instars, but they distributed themselves more evenly as they matured ; the young adults, however, again formed aggregations before flying to their aestivation quarters. The third type of distribution was in strips in a field, owing to accidental variations in ploughing or sowing, and the fourth was along the borders of a field. This was the least frequent and of short duration, occurring early in spring along the edges of fields adjoining groups of trees under which bugs were overwintering. Patchiness in distribution was very prominent during aestivation, becoming increasingly so from north to south. In European Russia, bugs that do not complete their development by harvest remain in the stubble feeding on weeds and any remaining cereals, but in Central Asia they rapidly disappeared after the harvest owing to the heat at the soil surface, the dryness of the air and the desiccating wind. Large numbers congregated for 2–3 days under sheaves or artificial shelters, where they could be destroyed.

Behaviour during the day was similar to that observed in European Russia from about the end of March to the beginning of May, during which period rains are frequent, the mornings and evenings are cool, and there are spells of cold weather. The bugs abandoned their shelters in the morning and ascended the plants, descended them between 11 a.m. and noon, when the temperature rose, ascended them again towards evening and spent the night in shelter on the soil [*cf.* **34** 48]. From May onwards, however, when the cereals began to form ears and the temperature was not less than 20°C. [68°F.] overnight and over 30°C. [86°F.] during the day, the bugs remained constantly on the tops of the plants and fed on the ears even at night. Other forms of activity, such as pairing, oviposition and migration, also occurred at night.

Observations on the reaction of the bugs to natural factors showed that they do not avoid exposure to the sun even during the hottest hours. They were not displaced by heavy rain or normal wind, and damage was increased in hot windy weather because the swaying of the plants and acceleration of evaporation from the body surface induced the bugs to puncture the grains more frequently. The bugs were easily startled, however, and it was found that sudden noise, shadow or movement increased the effectiveness of mobile traps. Feeding was less intense in the moister parts of a field, probably because the water requirements of the bugs were more quickly satisfied, and damage could

therefore be reduced by increasing the moisture content of the plants by irrigation.

Experiments on the control of the bugs by dusting with calcium arsenite applied from an aeroplane [*cf.* **33** 303] were carried out in northern Kirghizia in May 1943. No control was obtained on winter wheat dusted at the rate of 4·5 lb. per acre in dry hot weather on 12th or 19th May, evidently because the rate of application was too low, and the dust actually appeared to stimulate oviposition. Good results were obtained, however, when calcium arsenite was applied at 7·2 lb. per acre in irrigated fields on 30th May, when the wheat was in ear, the mortality of the adults reaching 88·9 per cent. five days later, as compared with 17·6 per cent. in the control, and the average number of nymphs being greatly reduced. The effectiveness of the treatment is explained by the fact that when the cereals are in ear, the bugs imbibe free water with increasing frequency. This was provided in the experiment by slight rain that fell two days after dusting ; calcium arsenite is soluble in water and was thus ingested by the bugs. It was found in the course of the work that the calcium-arsenite dust was unaffected by exposure to the sun for over 10 days. It adhered well to the plants, even in strong wind, but was easily washed off by rain. Egg parasites were apparently not affected by it.

Preliminary experiments in October and November, which are briefly recorded, showed that smoke from burning vegetation and litter (alone or with the addition of horse or cow dung) induced the bugs to leave their hibernation quarters and fly away, provided that the temperature was not lower than 18°C. [64·4°F.]. In field tests on a fairly large scale in Kashka-Dar'ya from about the end of March until mid-May, dung, straw and refuse was laid out in small heaps along the sides of square plots in fields of barley and wheat, and also along a line passing through the middle in a direction perpendicular to that of the prevailing wind. The heaps in the various situations were repeatedly lit when weather conditions favoured flight, the choice of the heaps depending on the direction of the wind, and observations showed that the smoke interrupted the feeding of the bugs already present, causing them to shelter on the ground, and prevented the immigration of fresh bugs. Nymphs were less affected than adults. The ultimate yield in a treated field of wheat was increased by over 25 per cent., as compared with an untreated one, fewer grains were punctured, and the viability of the punctured grains was less seriously reduced. The treatment was not improved by burning naphthalene or sulphur in the bonfires.

GERASIMOV (A. M.).] **Герасимов (А. М.). Description of the Pyralid *Chilo tadzhikiellus* Gerasimov and of the Noctuid *Sesamia cretica striata* Stgr., injurious to Sugar-cane in Tadzhikistan.** [*In Russian.*]—*Trud. zool. Inst. Akad. Nauk SSSR* **8** pt. 4 pp. 700–713, 9 figs., 28 refs. Moscow, 1949.

Descriptions are given of the adults, larvae and pupae of *Chilo tadzhikiellus*, sp. n., and *Sesamia cretica striata* Stgr., larvae of which were observed boring in sugar-cane in south-western Tadzhikistan in 1939–40 and 1940, respectively, together with a key to the Lepidopterous larvae that develop in sugar-cane stems, showing the distribution of some of them. *C. tadzhikiellus* is apparently indigenous, as the collection of the Zoological Institute in Moscow contains two specimens taken in the same area in 1934 and 1935.

BÖHM (H.). **Untersuchungen über die San José-Schildlaus (*Quadraspidiotus* (*Aspidiotus*) *perniciosus* Comst.). (1. Mitteilung. Wirtspflanzen und Schädling.)** [Investigations on the San José Scale (*Q. perniciosus*). (1st Communication. Host Plants and Pest.)]—*Pflanzenschutzberichte* **6** pt. 5–6 pp. 65–76, 16 refs. Vienna, 1951. (With a Summary in English.)

The author gives a list from the literature of the plants other than fruit trees and bushes on which *Quadraspidiotus perniciosus* (Comst.) has been

recorded in Austria. During investigations there in 1947–50, the Coccid was observed on trees and other plants of eight further species. In tests of the ability of these and nine other plants to support continuous infestation, development was completed and crawlers were produced on only ten. Details of the severity of the infestations and the numbers of crawlers produced per female are included.

Böhm (O.). **Zur Kenntnis des Roten Weidenblattkäfers** *Melasoma saliceti* **Wse. (Col., Chrys.).** [A Contribution to Knowledge of *M. saliceti*.]—*Pflanzenschutzberichte* **6** pt. 5–6 pp. 77–87, 1 fig., 22 refs. Vienna, 1951. (With a Summary in English.)

Melasoma saliceti Weise is a frequent pest of willow and poplar in Austria. In laboratory studies of its bionomics, in which poplar leaves were provided as food, the females laid their eggs in 8–10 batches averaging 49·2 eggs each, and the egg, larval, prepupal and pupal stages lasted about 6, 17, 1·5 and 6·5 days, respectively. There were three larval instars. The larvae at first fed in groups but dispersed towards the end of the first instar. The young larvae fed only on the undersides of the leaves, but those in the third instar skeletonised them and the adults ate all but the main veins. Pupation took place on the leaves. Two generations a year and a partial third were reared from overwintered adults collected in the field. Pairing was rare among adults of the second generation, and few of the females oviposited. The majority went into diapause 2–3 weeks after emergence and survived at 8–12°C. [46·4–53·6°F.] until December, when they died from unknown causes. Third-generation adults were reared without difficulty from the few fertile eggs laid.

Watzl (O.) & Böhm (O.). **Über ein sicheres Merkmal zur Unterscheidung der Eier von** *Leptinotarsa decemlineata* **Say und** *Coccinella septempunctata* **L.** [On a reliable Character differentiating Eggs of *L. decemlineata* and *C. septempunctata*.]—*Pflanzenschutzberichte* **6** pt. 9–10 pp. 131–133, 1 fig., 3 refs. Vienna, 1951. (With a Summary in English.)

Coccinella septempunctata L. often oviposits on potato plants in Austria, and the eggs closely resemble those of *Leptinotarsa decemlineata* (Say). They differ from the latter, however, in that, under high magnification, they show numerous fat-like droplets on the exochorion, the appearance of which is described and illustrated.

Florey (E.). **Untersuchungen über den Wirkungsmechanismus von Insektiziden.** [Investigations on the Mechanism of Action of Insecticides.]—*Pflanzenschutzberichte* **6** pt: 9–10 pp. 134–152, 8 figs., 20 refs. Vienna, 1951. (With a Summary in English.)

The physiology of the nervous systems of vertebrates and insects is briefly reviewed, with special reference to the mechanism of neuro-muscular and synaptic transmission, and an account is given of investigations in Austria on the effects of E 605 [parathion] and DDT on nerve enzymes [*cf. R.A.E.*, A **38** 233 ; **39** 427 ; **40** 147, etc.]. Preliminary tests showed that the action of cholinesterase from nervous tissue (spinal marrow) of cow, and muscle of leech (*Haemopis sanguisuga*) was not appreciably inhibitedby 1 per cent. DDT, but was considerably reduced by E 605 at 1 : 100,000 and by eserine, a known inhibitor, at 1 : 1,000,000. The motor reactions of

cockroaches (*Blatta orientalis* L.) treated with various materials were studied by means of a recording apparatus consisting essentially of an adjustable stand and a revolving drum covered with paper. One rear leg of the test insect was attached to the stand and the other to a mobile arm arranged so as to record the movements of the insect on the paper. Characteristic diagrams were obtained for untreated insects and for those into which solutions of picrotoxin, which the author has shown in unpublished work to inhibit a ferment that controls the sensory nerves, or eserine were injected. The movements of cockroaches to the ventral surfaces of which concentrated oil solutions of DDT or E 605 were applied by means of a brush were similarly studied, and it is concluded from a comparison of the results that E 605 inhibited both cholinesterase and the ferment that controls the sensory nerves, while DDT probably only excited the sensory nerves or inhibited the ferment that controls them. The presumed loci of action of picrotoxin, eserine and the two insecticides are shown in a diagram.

HENNER (J.). **Untersuchungen über die Anwendbarkeit des Frostspritzverfahrens im Weinbau zur Bekämpfung des Wintereies der Reblaus.** [Investigations on the Applicability of the Frost Spraying Technique in Viticulture for the Control of the Winter Eggs of *Phylloxera vitifoliae*.]—*Pflanzenschutzberichte* **7** pt. 1–2 pp. 1–10, 20 refs. Vienna, 1951. (With a Summary in English.)

Infestation by *Phylloxera* (*Dactylosphaera*) *vitifoliae* (Fitch) of the leaves of American vines grown for stocks in Austria has increased in severity since 1945, and in view of the improved control of fruit-tree pests given by dormant sprays applied in frosty weather [*cf. R.A.E.*, A **40** 132, etc.], the effect of such treatment on the winter eggs of the Aphid was investigated near Vienna. Following a promising preliminary test in 1949, a more detailed experiment was carried out in 1950. The materials used were tar distillates (two fruit-tree carbolineums), a tar distillate with mineral oil, and dinitro-o-cresol, and they were applied under high pressure to the stems of the vines in March at temperatures above and below freezing point. The results were estimated by counting the galls on the leaves in late May. All materials gave very satisfactory control and were as effective at half the normal concentrations in frost conditions as at the normal ones in warm weather. No damage was caused to the vines by any of the treatments.

BÖHM (H.). **Dinitro-sec. Butylphenol—ein neues Winterspritzmittel zur Bekämpfung der San José-Schildlaus** (*Quadraspidiotus perniciosus* **Comst.).** [Dinitro-o-sec.-butylphenol—a new Winter Spray for the Control of the San José Scale (*Q. perniciosus*).]—*Pflanzenschutzberichte* **7** pt. 1–2 pp. 11–15, 2 refs. Vienna, 1951. (With a Summary in English.)

A proprietary spray material containing 36 per cent. dinitro-o-sec.-butylphenol was tested in Austria during the winter of 1950–51 for effectiveness against *Quadraspidiotus perniciosus* (Comst.). Various fruit trees in the field were sprayed in January or February, and infested twigs were dipped in the laboratory. Dipping tests were also carried out with twigs bearing overwintering eggs of *Aphis pomi* Deg., *Operophtera* (*Cheimatobia*) *brumata* (L.), and *Paratetranychus pilosus* (C. & F.). A concentration of 0·7 per cent. of the material gave complete or practically complete control of *Q. perniciosus* in both series of tests, and at least 90 per cent. control, as compared with no treatment, of the other pests.

HORBER (E.). **Untersuchungen über die gelbe Getreidehalmfliege** *Chlorops* (*Oscinis*) *pumilionis* **Bjerkander 1778 und ihr Auftreten in verschiedenen Höhenlagen der Schweiz.** [Investigations on the Gout Fly, *C. pumilionis*, and its Occurrence at various Altitudes in Switzerland.]—*Landw. Jb. Schweiz* **64** pt. 9 pp. 887–1000, 2 pls., 49 figs., 6½ pp. refs. Berne, 1950. (With a Summary in French.)

The author gives a list of phytophagous Chloropids showing the plants that they attack, reviews the synonymy and morphology of all stages of *Chlorops pumilionis* (Bjerk.), and describes investigations in 1946–50 on its bionomics and control in Switzerland, where it is an important pest of cereal crops. It had two generations a year throughout its range, which extended to the upper limit of grain cultivation at about 5,500–6,000 ft. Rye was the chief food-plant of the winter generation, but winter wheat and barley and couch grass (*Agropyrum repens*) were also infested. Spring rye and barley, and particularly spring wheat, were attacked by the summer generation, but oats were practically immune. There was considerable seasonal dimorphism, and investigations showed that the coloration of the adults was dependent on the temperature to which the larvae were subjected.

Females of the overwintered generation laid their eggs singly on the leaves and stalks of the plants in May and the first half of June, 3–5 days after emergence. The larvae bored in the stems, causing stunting and thickening [*cf. R.A.E.*, A **12** 476]. The resulting adults appeared between mid-July and early September, and 90–95 per cent. of them underwent a diapause, pairing and ovipositing in September and early October. The larvae of the following generation overwintered in the stalks and pupated in spring. In the laboratory, the egg stage lasted about 7–8 days at 14–15°C. [57·2–59°F.], each of the three larval instars 12–24 days at 18–19°C. [64·4–66·2°F.], and the pupal stage 21–28 at 16–17°C. [60·8–62·6°F.]. Development ceased at temperatures below 4–4·5°C. [39·2–40·1°F.]. The adults normally fed on pollen, nectar, or other sweet substances, but food was not essential for oviposition, and one female given only water laid 97 eggs. Those of the summer generation survived for about 14 weeks, and those of the winter generation for only three. Most of the damage was caused by larvae of the summer generation, and the results are given of tests on varietal susceptibility in several of the summer and winter food-plants. *C. pumilionis* was parasitised by the Braconid, *Coelinius niger* (Nees), and the Pteromalids, *Stenomalus micans* (Ol.) and *Callitula bicolor* Spin. *Coelinius* oviposited in the host egg, developed in the larva and emerged from the host pupa. *Stenomalus* is an ectoparasite and fed on the larvae, including those parasitised by *Coelinius*. Parasitism by these two species ranged up to 95·8 per cent. in July. *Callitula* emerges from the pupae, and was observed in two localities only, the parasitism percentages being 10 and 20.

In field experiments at four different altitudes to ascertain whether the date of sowing affected infestation, late sowing in autumn, as sometimes recommended, afforded protection from the winter generation [*cf.* **37** 262], but exposed the plants to increased attack by the following summer generation. Early sowing is recommended for spring cereals, though it was effective in only one of the four localities. Infestation was heavier at the edges of fields than in the centre, so that very small plots, such as occur in the mountains, were especially vulnerable. Other cultural methods recommended include removal of couch grass and self-sown cereals, which serve as intermediate food-plants in autumn, and avoidance of any cultural operations that discourage the rapid growth of the plants. Infestation of spring wheat and barley on soils deficient in phosphates and potash was reduced when these deficiencies were remedied.

In field tests on control, in which two applications were made to spring wheat, sprays of DDT, benzene hexachloride or chlordan proved ineffective,

but one containing 0·02 per cent. parathion significantly reduced infestation. Since the attack was low, even in the untreated plots, it was suspected that an earlier spray of DNC (dinitro-o-cresol) that had been applied as a weed-killer had had some effect on the fly. In a further test on winter wheat, sprays of 0·02 per cent. parathion and 1·5 per cent. of a material containing 13·3 per cent. DNC were applied twice in October, before the majority of the eggs had been laid. The subsequent percentage infestation was reduced to 1·25 and 2·42, respectively, as compared with 13·75 in the controls.

EICHLER (W.). **Die Tierwelt der Gewächshäuser.** [The Animal World of Glasshouses.]—iv+93 pp., 11 figs., 291 refs. Leipzig, Geest & Portig, 1952.

This book is based on work by the author in the Botanical Gardens at Berlin in 1936–38, supplemented by the literature and records from other observers, and deals largely with arthropods. It is arranged systematically and consists essentially of lists of species found in glasshouses in Germany, with indications as to their abundance, distribution and feeding habits, and whether they are indigenous or imported. A review by C. Börner of the Aphids of glasshouses is included.

KUENEN (D. J.) & VAN DE VRIE (M.). **Waarnemingen over de biologie en de bestrijding van de appelzaagwesp (*Hoplocampa testudinea* Klug, Hymenopt., Tenthredinidae).** [Observations on the Biology and Control of the Apple Sawfly.]—*Tijdschr. PlZiekt.* **57** pt. 5 pp. 135–157, 10 figs., 6 refs. Wageningen, 1951. (With a Summary in English.)

With the improvements in cultural methods and in the standards of marketable fruit, *Hoplocampa testudinea* (Klug) has in recent years increased in importance on apple in Holland. Its bionomics are described from observations and the literature [*R.A.E.*, A **20** 579], and an account is given of experiments on control carried out in 1946–49.

The adults emerge in late April, and the females oviposit in the open apple blossoms. The larvae hatch in 8–20, usually 12, days, feed at first in the egg cavity and then tunnel into the fruitlets. Sometimes they emerge and bore afresh into the same or other fruits. When they reach the centre, they consume the seeds and then migrate to another fruit. Three to five young apples may thus be attacked by one larva. The fully-fed larvae overwinter in the soil and pupate in the following spring, though some remain in the soil for a further year. The date of emergence of the adults depends on soil temperature, and the flowering of apple on air temperature, so that the relation between the two was not constant from year to year, even for a given variety. The relations between oviposition and flowering in different varieties in 1946, 1948 and 1949 are shown on graphs.

Dusting the soil with DDT proved useless against the emerging adults, and spraying the trees with DDT against the ovipositing females before the flowers open gave insufficient control. The best results were obtained with sprays directed against the eggs and the newly hatched larvae. Derris, cubé (*Lonchocarpus*), nicotine, BHC (benzene hexachloride) and parathion were tested in the orchard, and sprays of 0·1 per cent. γ BHC gave complete control when applied between petal-fall and the hatching of the first larvae, the fruits escaping all injury. The other materials also gave good results, but they did not remain effective for long and the applications had consequently to be carefully timed. Sprays applied after hatching had begun caused high mortality, but did not prevent damage to the fruits.

In laboratory tests, small pieces of plant tissue bearing eggs were excised and placed on damp filter paper, and drops of the spray liquids allowed to fall

on them. Cubé killed all the eggs in a short time, nicotine killed most of them but was slower in action, and BHC had little ovicidal effect but killed the larvae as they hatched. In experiments on the effect against individuals migrating from one apple to another, larvae were placed on fruits that had been dipped in the various sprays ; 0·1 and 0·2 per cent. DDT were ineffective, BHC did not give complete mortality even at double strength, but cubé (5 per cent. rotenone) gave high mortality at 0·3 per cent. and was very effective at 0·5 per cent.

BHC did not affect the flavour of the apples in the field tests, and is widely used, normally with excellent results.

DÜRR (H. J. R.). **A preliminary Study of the relative Toxicity of Tanalith K and Dieldrin to young Larvae of the European Houseborer,** *Hylotrupes bajulus* **L.**—*J. ent. Soc. sthn Afr.* **14** no. 2 pp. 144–147, 3 refs. Pretoria, 1951.

Preliminary tests of the relative toxicity to larvae of *Hylotrupes bajulus* (L.) of pentachlorophenol, which is commonly used as a timber preservative, Tanalith K [*cf. R.A.E.*, A **37** 282 ; **38** 261] and dieldrin, stated to contain not less than 85 per cent. 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene, were made in South Africa during the summer of 1950–51. The tests were carried out by the larval-transfer technique [**38** 260], using small blocks cut from sapwood of *Pinus pinaster*, which were soaked in solutions of the materials in such a way as to give absorptions of 0·26, 0·24 and 0·013 lb. crystals per cu. ft. timber, respectively. After drying for some weeks in the sun, each block was infested with six day-old larvae and stored for 28 days at room temperature and a relative humidity of 75 per cent. Tanalith and dieldrin gave complete mortality, and pentachlorophenol reduced infestation to 28 per cent., as compared with 90 per cent. for no treatment. There were no signs of feeding in blocks treated with dieldrin, but there had been slight feeding in those treated with the other two materials.

STEYN (J. J.). **The Effect of low Calcium, Phosphorus or Nitrogen on the Life-cycle of Red Scale (*Aonidiella aurantii* Mask.).**—*J. ent. Soc. sthn Afr.* **14** no. 2 pp. 165–170, 1 fig., 5 refs. Pretoria, 1951.

Variation in the incidence of *Aonidiella aurantii* (Mask.) in South Africa is largely due to climatic and related factors, but it was thought that the chemical composition of the soil, as it affects plant nutrition, might also be of importance. A preliminary experiment was accordingly begun in October 1943. Young lemon seedlings were grown for 31 months in sand watered weekly with a full nutrient solution and were then divided into four groups, of which one received the complete solution and the others solutions deficient in calcium, phosphorus or nitrogen until the end of the experiment. The plants were infested with crawlers of *A. aurantii* 13 months after the beginning of the differential treatment and nearly three months later, individual females on the upper surface of the leaves were isolated and surrounded by adhesive bands to confine the resultant crawlers ; daily observations were made for a further three months. Analyses of the leaves made ten months after the beginning of differential treatment showed that the content of phosphorus had not been reduced by the omission of this element from the solution, and the results for these plants were therefore inconclusive. There was a significant increase (2·98 days) in the duration of a generation on leaves deficient in calcium (with which were associated low magnesium and high potassium contents), and a highly significant decrease (5·21 days) on leaves deficient in nitrogen (which had high concentrations of phosphorus and chlorine), and this might result in more than the normal four

generations being produced during a year. It is concluded that soil conditions providing abundant nitrogen and little lime might be of value in retarding the development of *A. aurantii*.

DÜRR (H. J. R.). **The Effect of Parathion on the Pernicious Scale** (*Aspidiotus perniciosus* **Comst.).**—*J. ent. Soc. sthn Afr.* **14** no. 2 pp. 200–201, 1 ref. Pretoria, 1951.

In a preliminary test in Western Cape Province on the effect of parathion on *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.), apple trees were sprayed immediately after harvest in 1951 with 5 lb. 15 per cent. wettable parathion per 100 gals. at a pressure of 400 lb. per sq. in. Four weeks after spraying, the average number of living Coccids per 100 sq. ins. of twig surface on infested twigs had been reduced by about 93 per cent. as compared with a week before it.

MYBURGH (A. C.). **Studies on Laboratory Technique for the Development of new Ovicides against Codling Moth.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 279, ii+59 pp., 8 figs., 3 diagrs., 14 graphs, 3¼ pp. refs. Pretoria, 1947.

Since the inclusion of ovicides has become necessary in the spray schedule against *Cydia* (*Carpocapsa*) *pomonella* (L.) in orchards in the western Cape Province of South Africa and it was desired to test the value of various oils or other toxicants in oil in emulsion sprays, investigations of suitable laboratory techniques were begun in 1942 and the results are here discussed. Descriptions are given of methods for the production and handling of large numbers of eggs of *C. pomonella* and of *Argyroploce leucotreta* Meyr., which was used when eggs of *C. pomonella* were not available, the development of a spraying apparatus capable of producing the very light deposits required to kill eggs and giving a mortality range of 0–100 per cent., and experiments on the factors influencing the distribution and quantity of the deposit on the sprayed surface. The apparatus, which is described, was a modified version of Potter's spray tower [*R.A.E.*, A **29** 591] and light mineral oils, the standard summer ovicides, were used in experiments with it.

The mortality of the eggs was found to be variable, partly because some strains of moths deposited resistant eggs and also because it was affected by the nature of the surface on which the eggs were sprayed. The spray deposit tended to decrease towards the outer part of the sprayed area, but a more even distribution was obtained by increasing the turbulence within the tower, though if it exceeded a certain limit, the deposit at the outer edge became heavier than elsewhere. The quantity of the deposit was greatly affected by environmental conditions, and high temperatures and saturation deficiencies caused considerable evaporation of liquid from the atomised droplets. The effects on the weight of deposit of the amount of emulsifier present in oil sprays and the amount of agitation to which they were subjected during preparation were reduced to a minimum in the spraying apparatus, but could not be eliminated. The quantity of spray deposited could be regulated by air pressure, degree of atomisation, and degree of turbulence as affected by the size of the gap at the bottom of the tower. The performance of the apparatus under normal conditions varied at different times of the day and on different days, and necessitated periodic checking. The consistent results obtained over periods of about an hour when conditions were fairly constant indicated that its performance would be satisfactory under controlled conditions of temperature and humidity.

SMIT (C. J. B.). **Field and Laboratory Experiments with Insecticides against Locust Hoppers.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 304, [2+]78 pp., 35 refs. Pretoria, 1951.

A detailed account is given of laboratory and field experiments carried out in South Africa in 1946–47 to discover a substitute for sodium arsenite in poison baits for the control of locusts and to determine to what extent existing stocks of the standard bait of 3 per cent. sodium arsenite in maize bran could be diluted without loss of toxicity. Some of the results confirm those of similar experiments already noticed [*R.A.E.*, A **39** 147]. The test insects in the laboratory were hoppers of *Locusta migratoria migratorioides* (R. & F.) and *Locustana pardalina* (Wlk.) in phases *transiens* and *gregaria*, and it was found that baits of 0·5 per cent. BHC (benzene hexachloride) or 5 per cent. DDT in maize bran were less toxic to *Locustana* than the sodium-arsenite bait, whereas the BHC bait was the best against *Locusta*. Tests with sprays, in which the materials were applied to hoppers of *Locusta* in a spray tower, indicated that solutions of DNC (dinitro-o-cresol) were significantly more toxic than emulsions or solutions of BHC or DDT at the same concentrations and dosages.

Both baits and sprays were tested in the field in two localities against bands of hoppers of *Locustana*. The standard sodium-arsenite bait gave significantly higher mortality than those containing 0·5 per cent. BHC or 10 per cent. DDT, but the BHC bait appeared to be much more rapid in action. A mixture of 1·5 per cent. sodium arsenite and 0·5 per cent. BHC was more toxic in baits than either material used alone at the same concentration, but increasing the proportion of sodium arsenite in the mixture to 3 per cent. caused a loss in effectiveness, possibly because of repellency when the total insecticide content exceeds a certain limit. Maize bran was greatly superior to sawdust as a carrier for BHC [*cf.* **39** 147] and was significantly more effective when moistened than when applied dry [*cf.* **40** 138]. A bait of 1·5 or 1·8 per cent. sodium arsenite and 0·5 per cent. BHC in a mixture of bran and sawdust was as effective as 3 per cent. sodium arsenite in pure bran. It is therefore suggested that existing stocks of arsenical bait should be diluted with equal volumes of sawdust and 0·5 per cent. BHC added. In preliminary field tests with sprays, emulsified solutions of BHC were more toxic than solutions of DNC in oil at similar concentrations and rates of application.

PETTEY (F. W.). **The Cochineal (*Dactylopius opuntiae*) and the Problem of its Control in Spineless Cactus Plantations. Part I. Its History, Distribution, Biology, and what it has accomplished in the Control of Prickly Pear in South Africa.** PETTEY (F. W.) & MARAIS (S. J. S.). **Part II. The Control of Cochineal in Spineless Cactus Plantations.**—*Bull. Dep. Agric. S. Afr.* no. 296, [1+]34 pp., 10 figs., 1 fldg. table. Pretoria, 1950.

The first part of this bulletin contains accounts of the morphology and bionomics of *Dactylopius opuntiae* Ckll., its introduction into South Africa for the control of the prickly pear, *Opuntia megacantha*, its subsequent spread, and the limiting factors that it has encountered. Much of the information is taken from an earlier work by the author [*R.A.E.*, A **38** 416]. At the time of writing, about 90 per cent. of the area originally infested by *O. megacantha* in the Karroo and other parts of the eastern Cape Province had been cleared by the Coccid, assisted by felling of surviving defoliated plants ; most of the remaining infested area is in a belt within 50 miles of the coast [*cf.* **36** 172].

The second part deals with its status as a pest of the spineless species of *Opuntia* that are grown, principally in the Karroo, for fodder, and of the measures available for its control on them [*cf.* **36** 389]. It now occurs in almost all plantations in widely separated areas throughout South Africa and may

completely destroy many young plants and plants weakened by grazing, especially under semi-arid or drought conditions. All the commonly cultivated species and varieties of spineless cactus are susceptible to attack, but four with round leaf pads that are cultivated in the high, colder parts of the Karroo are not appreciably injured. They were less favoured by sheep than a susceptible species (*O. fusicaulis*) in preference grazing tests, but the animals appeared to thrive as well on them as on the latter, although they consumed less.

In field experiments on *O. fusicaulis*, fairly heavy infestations on the leaf-pads were controlled by two thorough and copious applications of an emulsified solution of 1 per cent. DDT made through a disk-type spray nozzle at a pressure of 50–75 lb. on 15th October and 3rd December 1946 ; the number of applications required depends largely on the pressure at which the spray is applied. Coccids on the fruits were not killed, even by a stronger spray, and infested fruits should therefore be removed before spraying. The sprayed leaf-pads were harmless to stock, even after three applications. A spray of 1 per cent. wettable DDT remained toxic for less than two weeks and killed only the crawlers. In later tests, a spray of 2 lb. 15 per cent. wettable parathion per 100 gals. was found cheap and effective, but plants sprayed with it should not be fed to stock for about a month.

The use of sprays is not recommended in the coastal areas, where *D. opuntiae* is checked by natural enemies [*cf.* **36** 172], and infestation is too severe and widespread in the dry, inland areas to the east of the Karroo for it to be practicable, but farther north it should be of value in preventing the spread of the Coccid and reducing injury by it. Measures to be adopted if control is to be possible in inland areas include the eradication of prickly pear and infested or neglected plantations of spineless cactus, monthly inspections during October–June, and regular harvesting of leaf-pads to prevent fruiting and maintain the plants at a height of about 6 ft., which facilitates spraying.

TARR (S. A. J.). **Leaf Curl Disease of Cotton.**—10×6¼ ins., v +55 pp., 12 pls., 1 map, 1 graph, 110 refs. Kew, Commonw. mycol. Inst., 1951. Price 12*s.* 6*d.*

In this book, the author has brought together and discusses much information on the leaf-curl virus disease of cotton, mainly in the Anglo-Egyptian Sudan, that has hitherto been scattered throughout the literature. The aspects dealt with include the discovery and spread of the disease in the Sudan, its present distribution there and in other parts of Africa, other conditions of cotton recorded as leaf-curl, other virus diseases of cotton and virus diseases of other malvaceous plants, the symptoms and histopathology of the disease and its effect on yield, the transmission of the disease in the field and the factors influencing it, the bionomics of *Bemisia tabaci* (Gennadius) (*gossypiperda* Misra & Lamba), the vector in the Sudan, the causal virus and its properties, alternative host plants of the virus, and control, including that of the vector.

PAGLIANO (T.). **Les ennemis des vergers, des olivettes et des palmeraies.**—2nd edn., [1+]366+v[+1] pp., 170 figs. Tunis, Off. Exp. Vulg. agric. Tunisie, 1951.

The first three-quarters of this book contains accounts of the appearance, economic importance, bionomics and control of the insects or groups of insects and other pests, arranged systematically, that attack fruit and nut trees, olives and date palms in Tunisia. The remainder is made up of a section on insecticides and auxiliary materials, with notes on their nature, the purposes for

which they are used, their effect on insect pollinators, and the antidotes for those that are toxic to man and domestic animals, a section on types of equipment for the application of insecticides, the text of the legislation relating to crop protection in Tunisia and notes on the various insects, all Coccids, against which quarantine regulations are in force there. A list of the pests arranged under their food-plants is appended.

SOURES (B.). **Contribution à l'étude des Lépidoptères de la Tunisie. Biologie des espèces nuisibles ou susceptibles de le devenir.**—*Ann. Serv. bot. agron. Tunisie* **21** (1948) [2+]211[+1] pp., frontis., 44 pls., 2 figs., refs. Ariana [?1950].

This work was compiled to remedy a lack of information on the Lepidoptera of Tunisia and deals with 63 species of actual or potential importance as pests of plants, arranged according to the type of plant attacked. Special attention is paid to Noctuids, notes on the general morphology and bionomics of which are given in an introductory section, and to species that injure market-garden and field crops or garden flowers, but there are also sections on pests of fruit and ornamental trees. The information on the individual species comprises descriptions of the various stages and brief accounts of their bionomics and food-plants. Lists of the plants showing the species that attack them are appended.

RUNGS (C.). **Sur l'extension spontanée au Maroc du** *Rhizobius* (*Lindorus*) *lophantae* **Blaisd. (Col. Coccinellidae).**—*Bull. Soc. ent. Fr.* **55** no. 1 pp. 9–11. Paris, 1950.

The author reports that the predacious Coccinellid, *Lindorus* (*Rhizobius*) *lophanthae* (Blaisd.), which had spread from Tripolitania to Tunisia and Algeria by 1937 [*cf. R.A.E.*, A **26** 410], is now present in Morocco. Between 1944 and 1949, it was observed attacking several Coccids there, including *Lepidosaphes beckii* (Newm.), *L. gloveri* (Pack.), *Parlatoria ziziphus* (Lucas) and *Chrysomphalus dictyospermi* (Morg.) on *Citrus*. *P. ziziphus* was apparently its favoured prey and was controlled by it in one locality in 1949. The Coccinellid tolerates a wide range of climate, as it was found at sea level and at heights of up to nearly 5,000 ft., but it may be adversely affected by the insecticides now commonly applied to Citrus.

PAPERS NOTICED BY TITLE ONLY.

BRYANT (G. E.). **A new Species of** *Longitarsus* [*menthobius*, sp. n.] **(Halticinae, Coleoptera) damaging Peppermint** [*Mentha piperita*] **in Southern Rhodesia.**—*Ann. Mag. nat. Hist.* (12) **3** no. 31 pp. 628–629. London, 1950.

HERING (E. M.). **Ein neuer Sellerie-Feind,** *Melanagromyza apii*, **sp. n. (Dipt. Agromyz.).** [A new Pest of Celery, *Agromyza* (*Melanagromyza*) *apii*, sp. n., from New South Wales.]—*Ann. Mag. nat. Hist.* (12) **4** no. 44 pp. 736–745, 5 figs. London, 1951.

HAWES (I. L.). **Index VIII to the Literature of American Economic Entomology January 1, 1945 to December 31, 1947.**—*Spec. Publ. Amer. Ass. econ. Ent.* no. 8 [9+] 805 pp. College Park, Md., 1951. Price $7.00. [*Cf. R.A.E.*, A **38** 88.]